Fortress

Fortress • 30

PUBLISHING

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Series editors Marcus Cowper and Nikolai Bogdanovic

First published in Great Britain in 2005 by Osprey Publishing,
Midland House. West Way, Botley. Oxford OX2 OPH, UK 443
Park Avenue South, New York. NY 10016, USA

Email: info@ospreypublishing.com

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A CIP catalogue record for this book is available from the British Library

ISBN I 84176 821 9

Editorial by Ilios Publishing Ltd (www.iliospublishng.com)
Design: Ken Vail Graphic Design, Cambridge, UK
Index by Alison Worthington
Maps by The Map Studio Ltd
Originated by The Electronic Page Company, Cwmbran, UK
Printed in China through World Print Ltd.

05 06 07 0809 10 9 8 7 6 5 4 3 2 1

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Dedication

To Nick and Ronald without whom this book would never have seen the light of day.

Artist's note

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Acknowledgements

Belgian Army Museum Brussels; Nick Cuyvers; Kurt Engelmann; Fort Eben Emael; Charles B. MacDonald Office of the Chief of Military History Department of the Army; National Archives am Records Administration; Ronald Pawly; Photo Centre de Documentation historiques des Forces armees; Len Shurtleff, Great War Society; Joost Vaesen. Colour photographs by Simon Dunstan.

The Fortress Study Group (FSG)

The object of the FSG is to advance the education of the public the study of all aspects of fortifications and their armaments, especially works constructed to mount or resist artillery.The F holds an annual conference in September over a long weekend with visits and evening lectures, an annual tour abroad lasting about eight days, and an annual Members' Day.

The FSG journal FORT is published annually, and its newsletter *Casemate* is published three times a year. Membership is international. For further details, please contact
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Introduction

The Brialmont forts

The Schlieffen Plan

Following the outbreak of World War I on 4 August 1914, the Brialmont forts surrounding Liege were reduced one by one by the systematic bombardment of 21cm Skoda mortars and 42cm Krupp 'Big Bertha' heavy howitzers. Fort Loncin on the western side of Liege held out until 15 August, when a German round penetrated the main ammunition magazine, causing a catastrophic explosion that entombed half of the fort's garrison of 550 men - arguably the result of basic design flaws and inadequate construction techniques. Fort Loncin was never rebuilt after the armistice, and it remains a memorial to the Belgian dead of World War I and the gallant defenders of Liege. The Belgian forts built during the 1930s were designed to withstand attack from heavy siege artillery and none fell to conventional assault, although Fort Battice suffered heavy casualties when Bunker I exploded. (National Archives and Records Administration)

The battle of Liege

The Versailles Treaty

The Maginot Line 1928-45

Verdun 1916

The Schlieffen Plan of 1914 was designed to envelop Paris from the north-east, but determined resistance from the Belgian. British and French armies disrupted the strategy and it faltered on the Marne andYser Rivers resulting in four years of ghastly trench warfare. In 1940, the Germans lured the British and French mobile forces into Belgium.They then unleashed the 'Sichelschnitt' or 'sweep of the scythe' to split the Allied armies and precipitate the fall of France in just 42 days. (© Osprey Publishing Ltd)

Position Fortifiee de Liege

Ruhrgebiet.

Position Fortifiee de Liege.

The creation of the Caster cutting through Mount St Peter was a triumph of civil engineering. It was designed and built by the Belgian company Entreprises Reunies with other companies acting as sub-contractors.These included the German firms of Hochtief A.G. of Essen and Dyckerhoff und Widman ofWiesbaden, but they were not involved with the construction of Fort Eben Emael.There have been several later assertions that these companies had complete plans of the fortress that allowed such a small force as Sturmgruppe Granit to capture Fort Eben Emael so quickly, but that was not the case. This view shows the southern end of the Caster cutting under construction, with the sheer face that formed part of Fort Eben Emael on the left.
(Photo Centre de Documentation historiques des Forces armees)

RIGHT **The diagram shows the location of the various forts of the Position Fortifiee de Liege at the outbreak of World War II. The circles around the various major fortresses represent the ranges of their respective artillery weapons, with the 120mm guns of Fort Eben Emael reaching almost to the German border.The inner circle indicates the range of the 75mm guns, while the innermost one is of the 81mm mortars.The map also shows the various towns, villages and geographical features in the vicinity of Fort Eben Emael that are mentioned in the text, together with the major Belgian army formations in the area.**
(© Osprey Publishing Ltd)

The new forts

Position Fortifiee de Liege 2

Position Fortifiee de Liege 1

BELGIUM
HOLLAND
GERMANY
120mm
75mm
Lanaken
Veldwezelt
Maastricht
Vroenhoven
Kanne
Lanaye Lock
Eben Emael
Meuse River
Aachen
Tongeren
Wonck
Visé
Albert Canal
Aubin Neufchâteau
Pontisse
Barchon
Evegnée
Battice
Liège
Fléron
Verviers
Flémalle
Chaudfontaine
Embourg
81mm
Boncelles
Tancrémont
Spa
N
Brige
Observation post
Fort
81 mm mortar, range 3,6 km
75 mm gun, range 10 km
120 mm gun, range 17, 5 km
0
5 miles
0
10 km

Named after King Albert I (1875-1934). the extension of the Albert Canal to avoid the waterway passing through Dutch territory was inaugurated on 30 May 1930 after a prodigious engineering endeavour to cut through Mount St Peter and create the Caster cutting. With the Lanaye locks to the right linking the original Albert Canal with the Meuse River, the cutting created a natural defensive position that became Fort Eben Emael. close to the site recommended by General Henri Brialmont as long ago as 1890. to form the northern fortress of the *Position Fortifiee de Uege.*

Chronology

21 July 1831 Belgium declares independence from the Netherlands.

19 April 1839 Major European powers guarantee Belgian neutrality with the Treaty of London.

1870-1871 Franco-Prussian War prompts Belgium to build new fortifications around its key cities of Antwerp, Liege and Namur.

1890 Completion of the Brialmont forts of the *Position Fortifiee de Liege* and *Position Fortifiee de Namur* protecting Belgium from invasion from Germany and France respectively.

3 August 1914 Germany declares war on France and invades Belgium.

4 August 1914 Britain and Belgium declare war after German troops enter Belgium.The Liege forts resist until 18 August while those of Namur fall after only four days to heavy German artillery.

1932-1935 Construction of Fort Eben Emael guarding the junction of the Meuse River and the Albert Canal north of Liege.

7 March 1937 German troops march into the demilitarized zone of the Rhineland in contravention of the Versailles Treaty.

1939
1 September Germany invades Poland
3 September France and Great Britain declare war on Germany

1940
10 May Fall Gelb - the German offensive in the west begins.
0400hrs - German gliders are sighted over Belgian territory.The Belgian government appeals to Great Britain and France for assistance.
0430hrs - German Army Group B under General von Bock advances towards the Belgian defensive line along the Albert Canal. German Army Group A under General von Rundstedt strikes through the Ardennes between Liege and the Moselle.
0424hrs -The first of nine gliders carrying Sturmgruppe Granit assault pioneers lands atop Fort Eben Emael.The assault pioneers use novel shaped charges to silence the guns of Europe's most powerful fortress in just 30 minutes. German troops seize intact two out of three bridges across the Albert Canal.
0630hrs - General Gamelin orders Allied troops into Belgium.
11 May 1215hrs Fort Eben Emael surrenders.
20 May Forty allied divisions are trapped in Flanders.
21 May Fort Aubin-Neufchateau surrenders.
22 May Fort Battice surrenders.
28 May At 0400hrs, King Leopold III surrenders to the Germans.
29 May Fort Tancremont surrenders.

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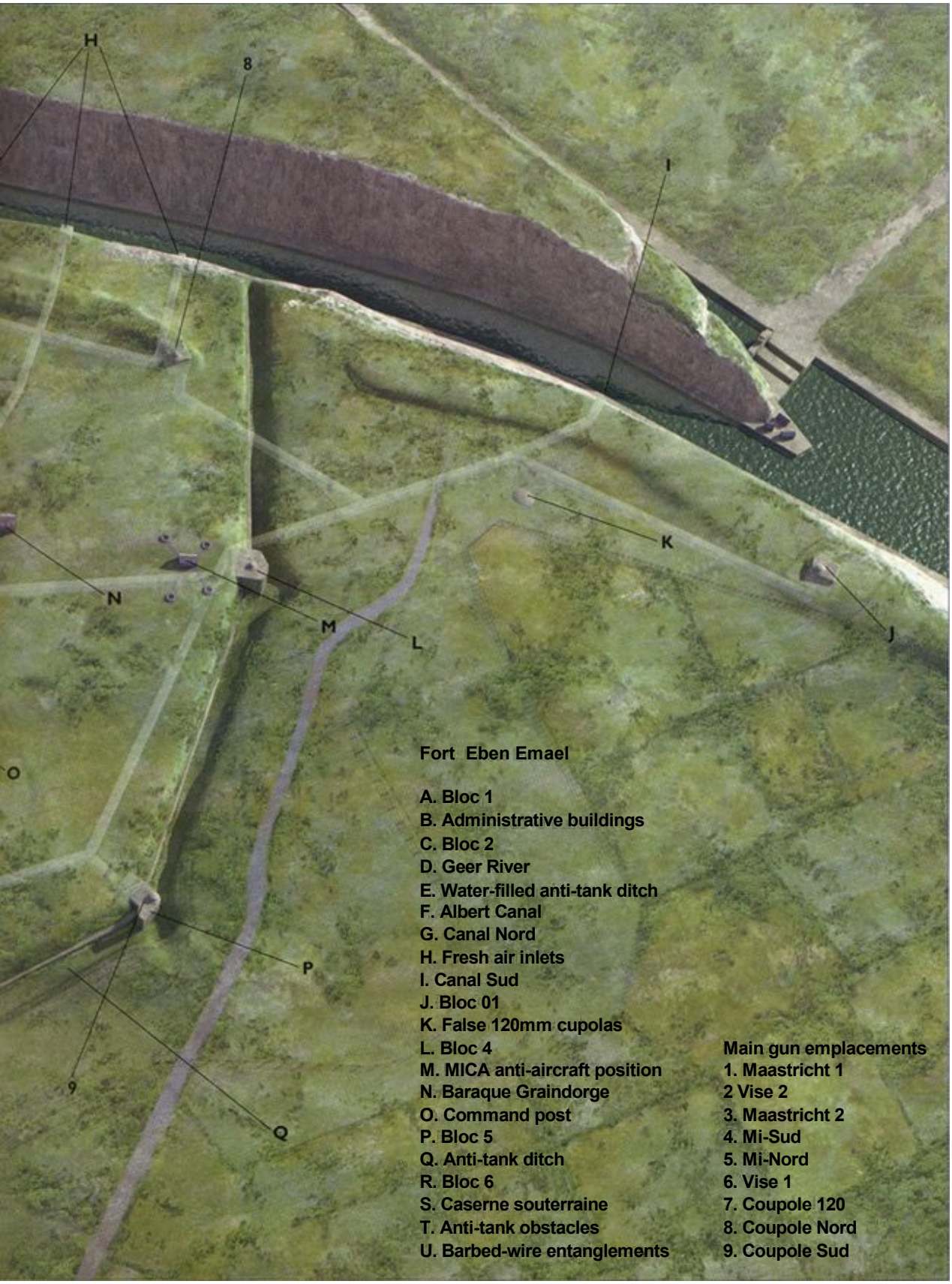


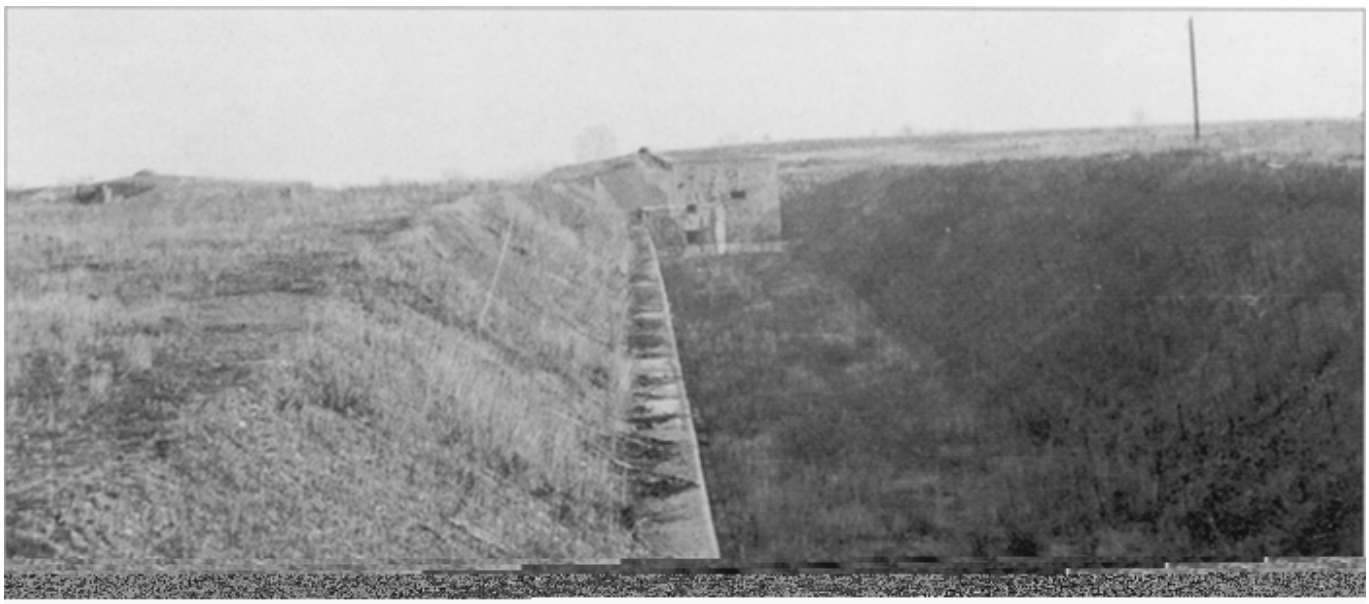
Fort Eben Emael

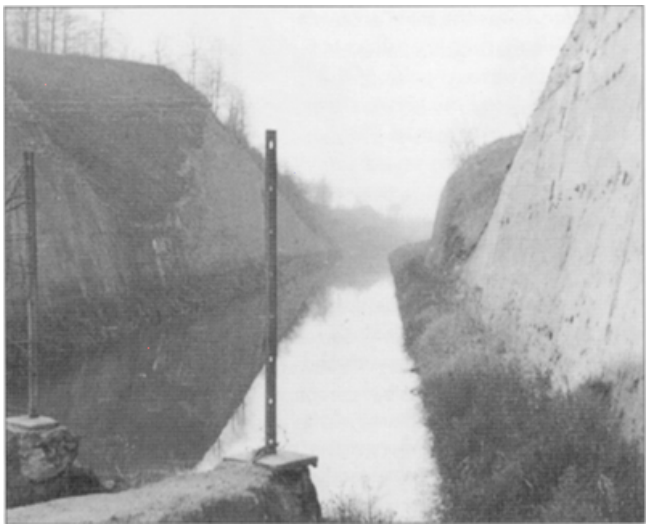
A. Bloc 1
B. Administrative buildings
C. Bloc 2
D. Geer River
E. Water-filled anti-tank ditch
F. Albert Canal
G. Canal Nord
H. Fresh air inlets
I. Canal Sud
J. Bloc 01
K. False 120mm cupolas
L. Bloc 4
M. MICA anti-aircraft position
N. Baraque Graindorge
O. Command post
P. Bloc 5
Q. Anti-tank ditch
R. Bloc 6
S. Caserne souterraine
T. Anti-tank obstacles
U. Barbed-wire entanglements

Main gun emplacements
1. Maastricht 1
2 Vise 2
3. Maastricht 2
4. Mi-Sud
5. Mi-Nord
6. Vise 1
7. Coupole 120
8. Coupole Nord
9. Coupole Sud

Fort Eben Emael

The configuration of the anti-tank ditch with its deep sides and concrete walls is readily apparent from this view looking towards Bloc 4 from Bloc 5. At the left of the photograph, on the skyline, is the armoured dome of Coupole Nord. Out of picture to the immediate left was the MICA anti-aircraft machine-gun position. It is apparent how little cover there was from the Belgian guns in the various casemates on the perimeter of Fort Eben Emael. and one of the reasons why it was thought to be impregnable to conventional attack.

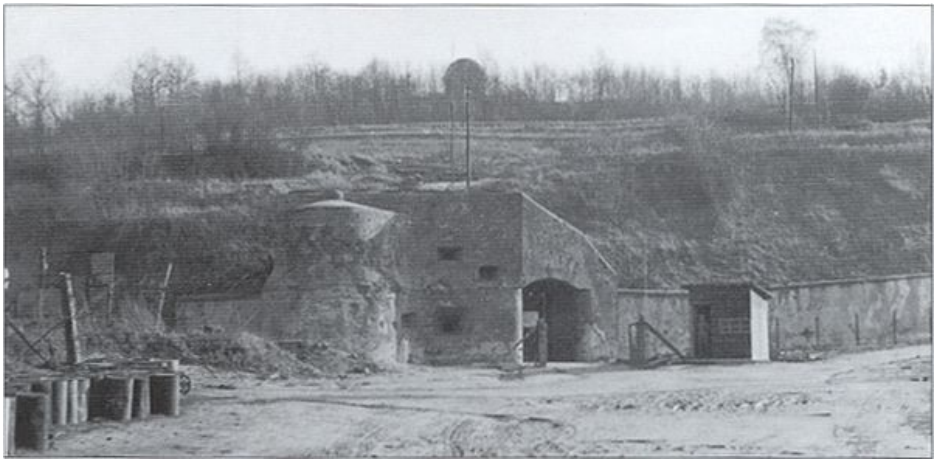




The blockhouses

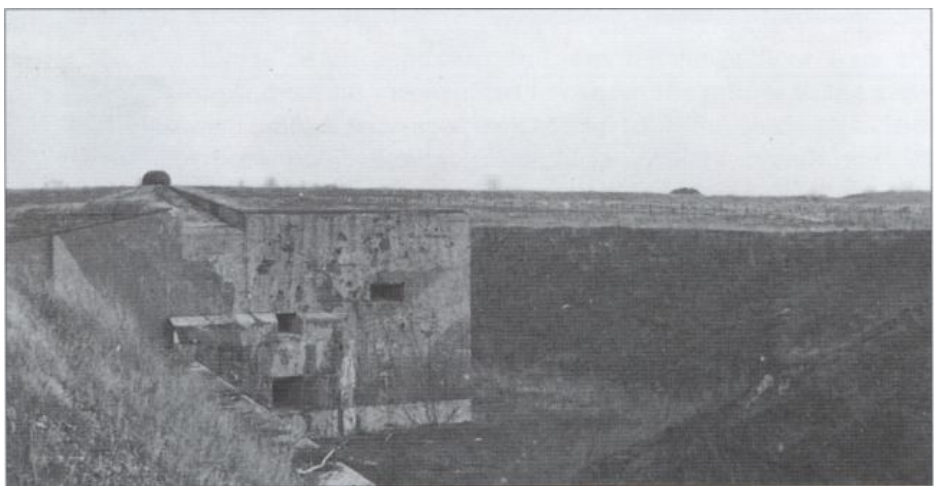
Along the western edge of the fortress was a 450m-long water-filled anti-tank ditch facing northwards towards the Albert Canal while to the left was the Geer River, which fed water into the anti-tank ditch,The right-hand photograph shows a view of the anti-tank ditch from the bank of the Albert Canal looking southwards towards Bloc 2, with the fortress up the hillside on the left. It was along this pathway that Hauptfeldwebel Portsteffen and I Zug of Pionierbataillon SI made their way to affect the belated link-up with Sturmgruppc Granit. Hauptfeldwebel Portsteffen and I Zug subsequently mounted an attack on Bloc 2 with flamethrowers and explosives to consolidate the situation. Portsteffen took many of the black and white photographs featured in this book soon after the assault. For his gallantry and outstanding leadership during the battle for Fort Eben Emael. Hauptfeldwebel Portsteffen was awarded the Ritterkreuz.The original plans for Fort Eben Emael incorporated a Bloc 3 at the northern tip of the fortress, but subterranean geological faults in the limestone precluded its completion, although a gallery was started from Mi-Nord.Thereafter, a cupola armed with an 81mm mortar and machine guns was envisaged, but it was never built and two false 120mm cupolas were installed instead.

RIGHT Bloc I was the main entrance to Fort Eben Emael. It was located at the south-western point of the fortress and faced the village after which the fort was named.This photograph was taken on the approach road to Bloc I. soon after the capture of Fort Eben Emael. Above Bloc I on the skyline is the dome of the main air ventilation outlet. Trupp 3 attacked this structure after they had disabled their primary target of Maastricht I. At 0445hrs. a 3kg charge was dropped down the ventilation shaft causing consternation amongst the underground garrison. Fortunately for them,Trupp 3 did not continue the attack as further explosives could have seriously damaged the ventilation system. Indeed, a new ventilation system had recently been installed for the fort, but it proved inadequate during the course of the battle and the garrison had to revert to the old one.



LEFT Bloc 2 was located on the western side of the fortress at the head of the water-filled anti-tank ditch that ran to the Albert Canal. Its guns dominated the ground to the north and they also interlocked with those of Bloc to the south. Stuka dive-bombers attacked Bloc 2 soon after the assault began. At 0630hrs,Trupp 3 detonated a 50kg hollow-charge weapon above the armoured observation dome killing the soldier inside. Several Belgian counter-attacks were mounted up the hillside to the right of Bloc as shown here.Those undertaken by the soldiers of the garrison at 0600hrs and 0800hrs were ineffective as they had no infantry training or modern weapons. Further counter-attacks over this ground were mounted by men of the I er Companie of the 2e Grenadiers around midday. Sporadic fighting continued around Maastricht I until 1700hrs, during which Oberjager Hiibel and Gefreiter Jiirgensen of Trupp 10, and Gefreiter Kruck of Trupp I I, were killed. Feldwebel Wenzel was also injured when a bullet grazed his head around I SOOhrs. It was at Bloc 2 that the first contact between the men of Pionierbataill on 51 and Sturmgruppe Granit occurred, but not until 0500hrs on I I May 1940, some 18 hours behind schedule.

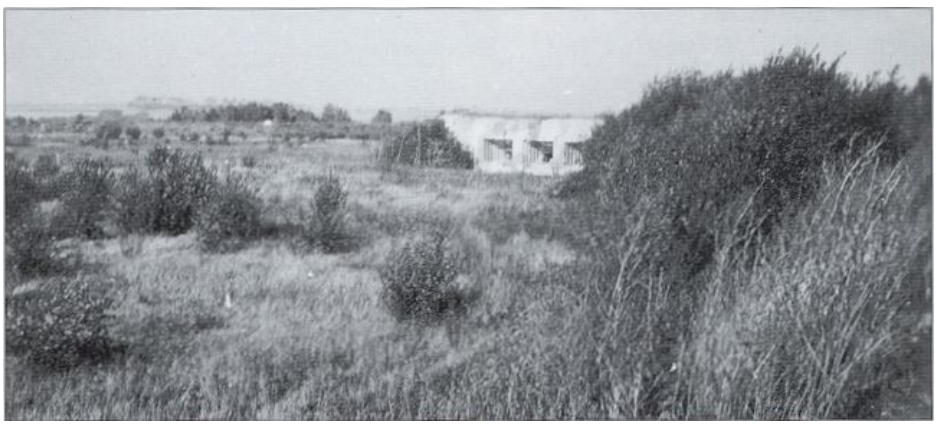
A view of the Albert Canal as it passes through the Caster cutting with Mount St Peter to the left and the sheer wall of the north-eastern side of Fort Eben Emael to the right. With a height of 40m it presented a formidable obstacle to any attacker. Built into the side of the fortress, along the western bank of the canal. were two defence works. Canal Nord and Canal Sud.These were armed with 60mm anti-tank guns, machine guns, and searchlights that dominated all approaches along the canal. During the battle, fire from Canal Sud destroyed a German machine-gun post at Lanaye, and fire from Canal Nord caused serious delays to the men of Pionierbataillon 51 trying to cross the canal in order to relieve the exhausted paratroopers of Sturmgruppe Granit. Realizing the threat posed by Canal Nord. the men of Trupp 6 under the command of Oberjager Harlos made several attempts during the night to destroy the position by lowering demolition charges on long lengths of rope, but with only limited success. Dirt from the explosions managed to obscure the optics of the armoured observation dome, but the 60mm anti-tank gun continued to fire on German positions in Kanne and around the destroyed bridge. It finally fell silent after a technical fault.

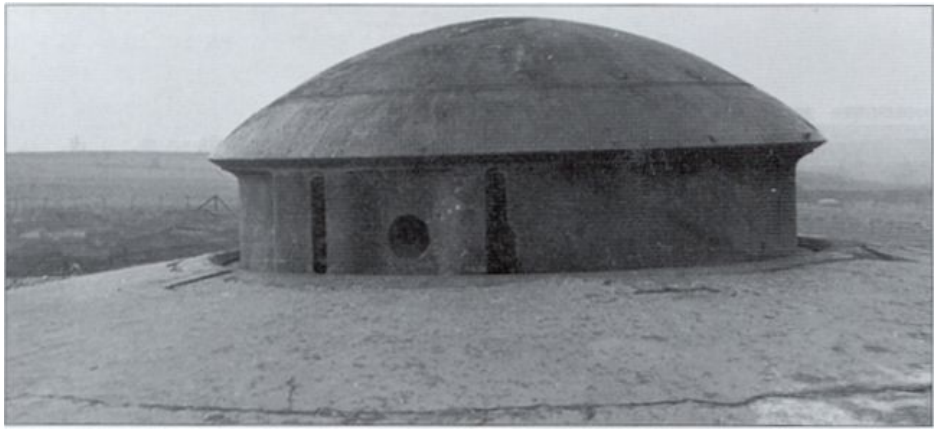


Bloc 4 was typical of the casemates protecting the southern and eastern sides of the fortress. Together with Blocs 5 and 6, these gun emplacements dominated the anti-tank ditches, and covered with fire the anti-tank obstacles and barbed wire entanglements to the south and east. Readily visible is the armoured observation dome that was destroyed by a 50kg charge detonated by Trupp 5 under the command of Feldwebel Haug. In the background to the right on the skyline is the dome of the third false cupola of Fort Eben Emael that was located outside the actual perimeter of the fortress and near to Bloc 01.The sheet steel dome is now on display outside Bloc I at the entrance to Fort Eben Emael as a museum exhibit.

The gun emplacements

The main triple 75mm gun casemates were named after the towns that their weapons covered with fire.Vise I faced southwards, as did Vise 2, and so they were not primary targets for Sturmgruppe Granit as their guns did not threaten the bridges over the Albert Canal. However.Vise I was the secondary target for Trupp 2. as its guns did dominate the surface of the fortress and so were a threat to the assault pioneers. As Trupp 2 never arrived at the fortress, the task was given to Trupp 10, and one 75mm gun was destroyed by a 12.5kg charge causing the Belgian gun crew to withdraw to the intermediate level. At 05lOhrs, Maj. Jottrand issued a fire mission but as there were no men present this was impossible. Accordingly, Maj. Jottrand informed the headquarters at Liege that Vise I was out of action. Sometime later, Lt. Desloovere returned to the gun gallery and further rounds were fired to the south. Any further fire was stopped by the command post at l030hrs on the pretext that a counter-attack was to be mounted on the top of the fortress. At l300hrs, the Germans silenced the guns ofVise I forever by detonating I kg charges in their barrels. In the left background of the top photograph is the gun emplacement Mi-Nord.The two casemates were linked by an earth rampart to landscape them into the terrain, and obscure observation of the fortress from the top of Mount St Peter across the Albert Canal. At the time of the assault, all the casemates were painted in earth-coloured stripes of brown and green and were masked with camouflage netting.

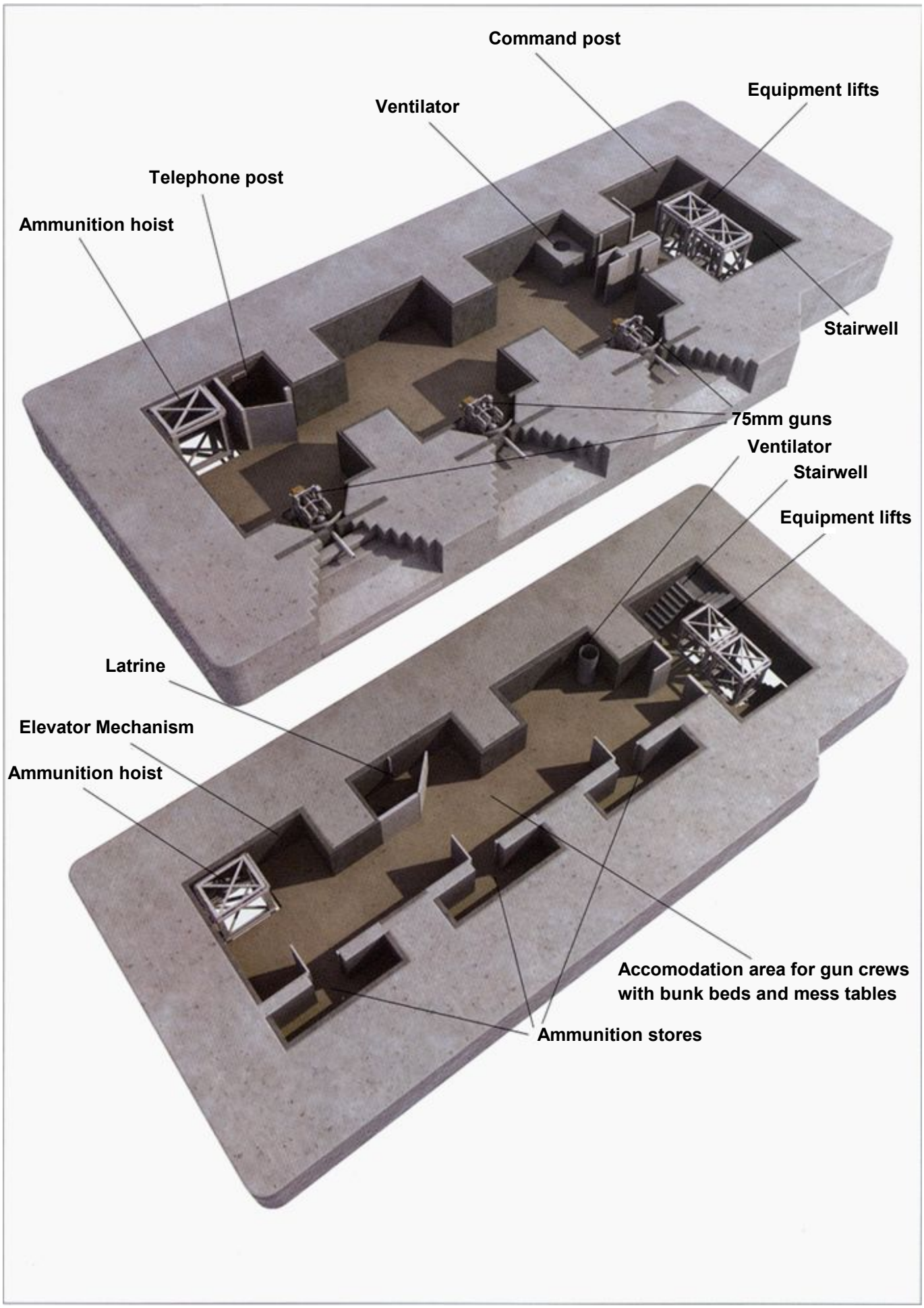




The retractable armoured gun emplacement Coupole Sud was not a primary target for Sturmgruppe GranitAs it was located at the southern tip of the fortress, the Germans did not believe that its guns could fire on the bridges over the Albert Canal to the north. Although attacked with a 50kg hollow-charge weapon during the initial assault. Coupole Sud remained in action throughout the battle. Around 0745hrs, it obtained canister rounds from the ammunition magazines of Coupole Nord.With these rounds lashing the top of the fortress, the troops of Sturmgruppe Granit were forced to take cover inside the captured casemates. If these canister rounds had been available prior to the glider landings, the outcome of the attack might have been very different. During the course of the battle, Coupole Sud fired several fire missions under the direction of observers in EBEN I, located above Bloc 01 overlooking the Lanaye locks and the Albert Canal to the south. From I030hrs. Coupole Sud laid effective fire on the German 269th Infantry Division in the village of Eysden, and also destroyed a pontoon bridge over the Meuse River. At the time of the surrender, Coupole Sud was put out of action by retracting the armoured dome and firing the 75mm guns underground.

Vise 2

The principal weapon systems of Fort Eben Emael were the four triple 75mm gun casemates covering the towns of Maastricht and Vise. None of the other forts in the Position *Fortifiee de Liege* had such gun emplacements.The latter were configured on three levels with the main ammunition magazines on the intermediate level of the fortress separated from the actual gun emplacement by two pairs of armoured double doors. The ammunition rounds were transported from the magazines by handcarts through the armoured doors and by means of lifts to the lower gallery of the gun emplacement.This level contained the ammunition storerooms and preparation areas for the rounds such as cleaning and fusing as well as the latrines for the gun crew that comprised five NCOs and 28 soldiers.The rounds were then passed up to the top level by three lifts two of which were situated in the centre of the stairwell that allowed the crew access to the gunroom. The 75mm quick-firing guns were based on the Krupp 1905 model that had been in service with the Belgian army since before the Great War. The guns had a field of fire in azimuth of 70 degrees with an elevation of-5 to +37 degrees. They had a maximum range of II km and a rate of fire of ten rounds a minute per gun. Above each gun was a telescopic sight for direct vision of the fortress roof in case of infantry attack but most artillery engagements relied on pre-planned fire orders that gave the bearing and elevation to engage the requisite target be it a bridge or an approach road. This type of fire mission was known as *feu d'interdiction* as it was intended to deny all the approaches of the Albert Canal bridges to the enemy. The fire orders came from the command post and were relayed to the gun crew by two telephonists in the upper level.The 75mm guns fired three types of rounds with two being high explosive and the other canister. The earlier model 75mm HE round had a range of 8km and contained 800g of explosive while the later round had a range of 11 km and contained 650g of explosive. Accordingly, these rounds were not heavy enough to cause any serious damage to the bridges themselves; for this reason the bridges were rigged with demolition charges if their destruction was necessary. The third type of round was a canister round that contained 234 12g lead balls for engaging troops in the open. The casemates were built of reinforced concrete up to 2.75m thick capable of sustaining prolonged bombardment from 22cm artillery rounds and all contemporary aerial bombs. The exteriors were painted in green and brown stripes and all the gun emplacements were masked from aerial observation by camouflage netting.


Command post
Equipment lifts
Ventilator
Telephone post
Ammunition hoist
Stairwell
75mm guns
Ventilator
Stairwell
Equipment lifts
Latrine
Elevator Mechanism
Ammunition hoist
Accomodation area for gun crews
with bunk beds and mess tables
Ammunition stores

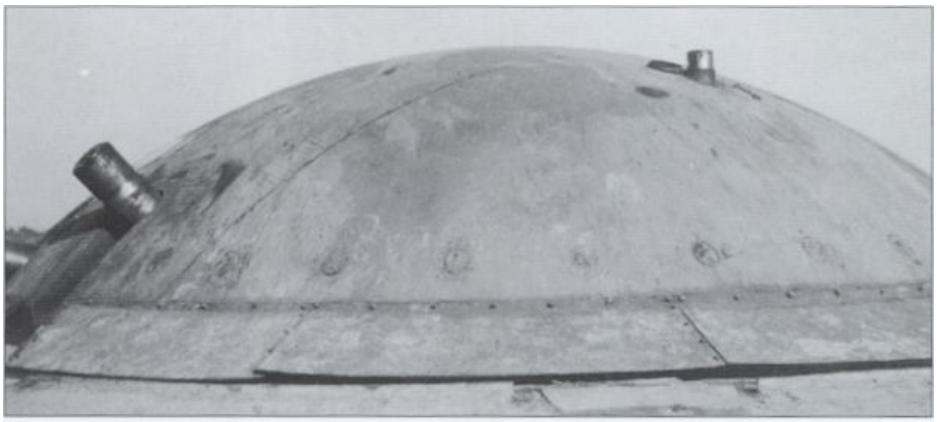
Boite a balks,

Mi-Nord was a critical target for Sturmgruppe Granit as its machine guns dominated the landing ground of the DFS 230 gliders. Although manned at the outset of the attack. the Belgian defenders were forbidden to open their ammunition boxes, and by the time they saw their attackers it was too late. After destroying the armoured observation dome EBEN 2 on top, the men of Trupp 4. under the command of Feldwebel Wenzel, blasted their way into the casemate with a 50kg charge.The Belgian gun crew withdrew to the intermediate level. Once inside the devastated casemate. Fw. Wenzel groped around in the billowing smoke when suddenly the telephone rang. Wenzel later recalled that it was the one moment of the attack that he was truly frightened. Nevertheless. he picked up the phone to hear someone speaking in a language he could not understand.With no knowledge of French, he replied in English - 'Here are the Germans' to which the response came - 'Oh mon Dieu!' and the telephone was disconnected.Wenzel subsequently destroyed the staircase down to the intermediate level to prevent any counter-attack by the Belgians. Mi-Nord became the German command post and field dressing station throughout the battle.

Mi-Sud was the companion gun emplacement to Mi-Nord. Both were armed with three double machine guns, and had armoured observation domes on top. That of Mi-Sud was capable of being fitted with a light machine gun. Mi-Sud was attacked by Trupp 9 commanded by Oberjager Ncuhaus. with a 50kg lodged into the southward facing machine-gun embrasure.The resulting hole in the structure allowed Trupp 9 entry into the gun emplacement, where they took up a defensive posture. Again, like Mi-Nord, the stairwell was destroyed with explosives to prevent I Belgian counter-attack

mitrailleuse

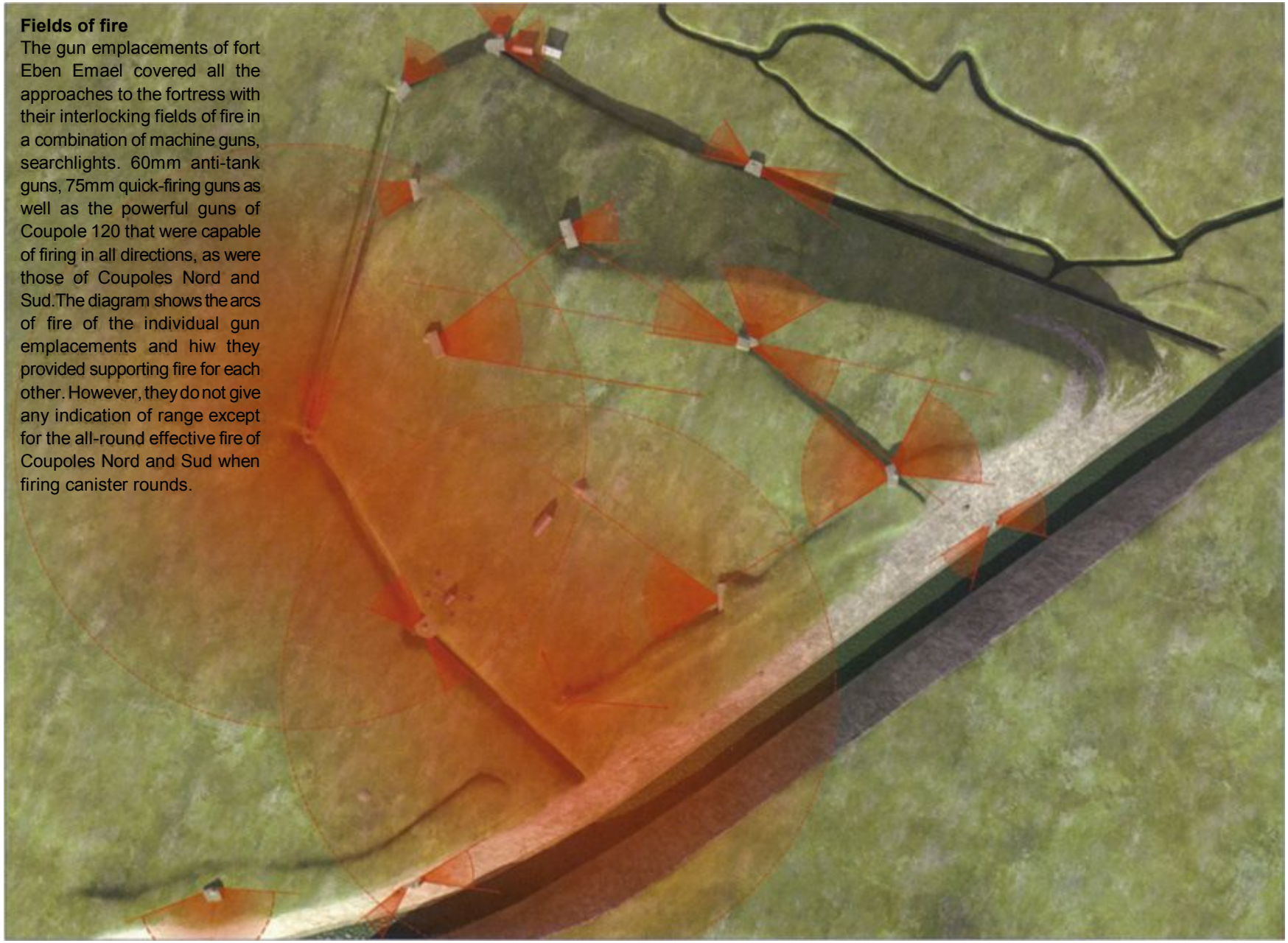
Coupole 120 was the most powerful gun emplacement of Fort Eben Emael. with a range as far as the German border. As the primary target for Trupp 2. it was spared attack in the initial assault. Unaccountably, its ammunition hoists failed to function, although they worked perfectly the day before. For many years there were dark tales of sabotage, but in all likelihood it was due to the inadequate maintenance procedures of a demoralized garrison. In any event, the guns of Coupole 120 failed to fire a single shot during the battle despite the plethora of targets around Maastricht, let alone the bridges over the Albert Canal. Protruding through the top of the armoured carapace is a periscopic sight; as related in the text, its horizontal telescope was never delivered but it was through this aperture that the gun crew engaged the advancing men of Trupp 5 and their Belgian prisoners with a rifle. wounding at least two.The colour photograph shows Coupole 120 in its dominating position in the centre of the fortress, with Vise I to the right in the background, and the damage caused by a 50kg charge above the left-hand gun.



Mitrailleuse contre avians)

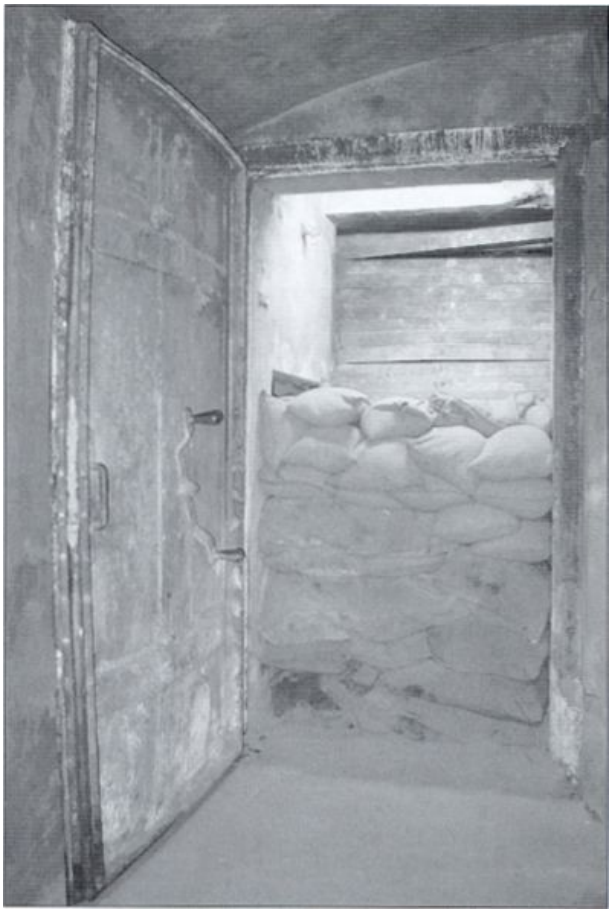
Fields of fire

The gun emplacements of fort Eben Emael covered all the approaches to the fortress with their interlocking fields of fire in a combination of machine guns, searchlights. 60mm anti-tank guns, 75mm quick-firing guns as well as the powerful guns of Coupole 120 that were capable of firing in all directions, as were those of Coupoles Nord and Sud.The diagram shows the arcs of fire of the individual gun emplacements and hiw they provided supporting fire for each other. However, they do not give any indication of range except for the all-round effective fire of Coupoles Nord and Sud when firing canister rounds.



Armoured doors

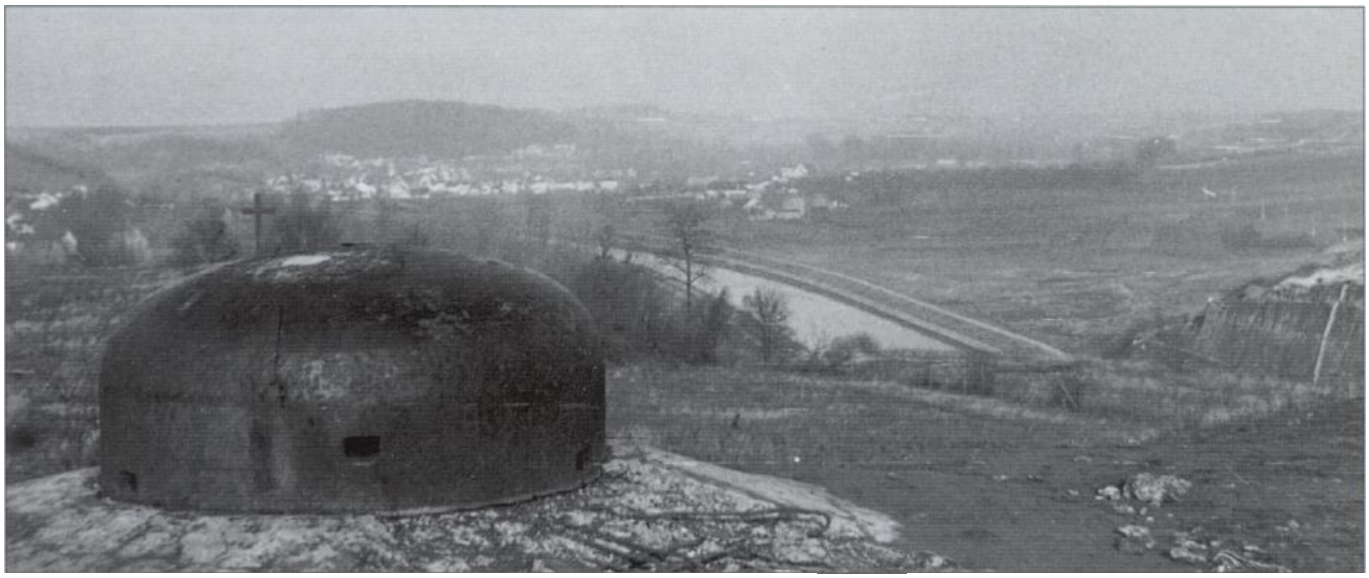
Caserne Souterraine



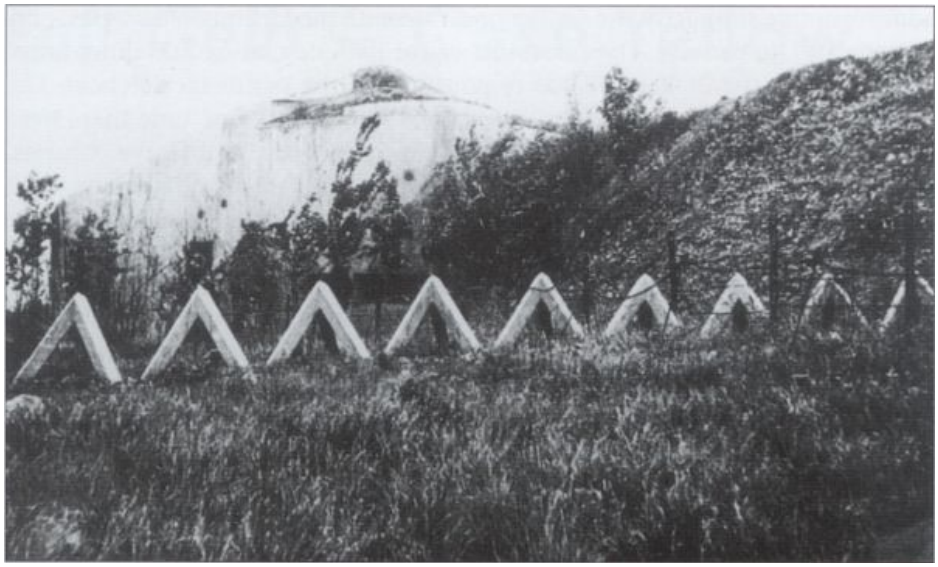
As an integral design feature of Fort Eben Emael. each and every gun emplacement could be isolated from the interior of the fortress by a pair of double armoured doors. Once the outer doors adjacent to the gun emplacement were closed. 8in. steel beams were slotted in behind them as further reinforcement.The 2m gap between the two sets of armoured doors was then filled with sandbags to absorb the force of any conventional explosives. These heavily armoured doors were formidable barriers to thwart any attacker that managed to capture a gun emplacement from entering the fortress.

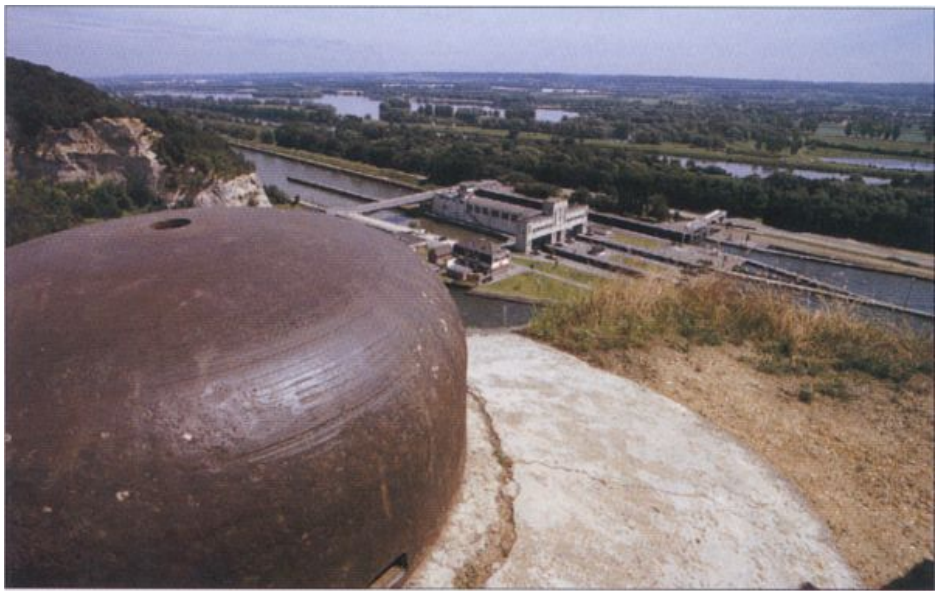
poste de commandement,

Observation posts



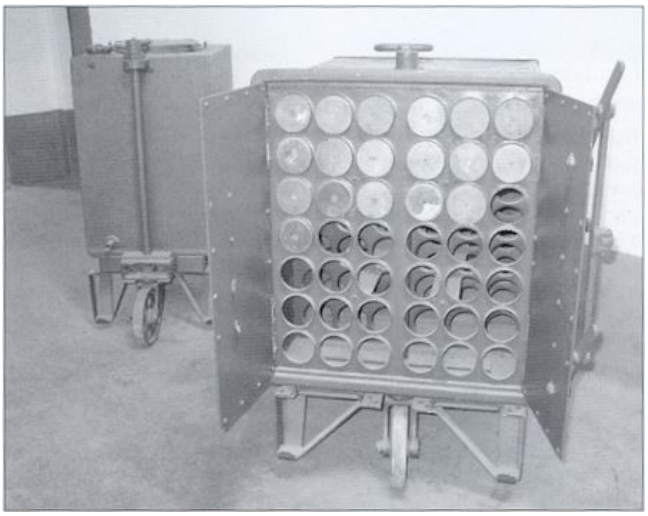
The armoured observation domes of Fort Eben Emael were well situated with wide fields of view. For this reason they were the priority targets for Sturmgruppe Granit. In the foreground is EBEN 2 atop Mi-Nord. with its line of sight overlooking the Albert Canal towards Maastricht. Although this photograph was taken soon after the battle, the damage caused by a 50kg hollow charge has already been disguised by filling the hole with concrete so as to preserve the secret of the *Hohlladungwaffe* for as long as possible. After the battle, numerous visitors from the German armed forces and foreign representatives were given guided tours of Fort Eben Emael to mark the outstanding feat of arms of Sturmgruppe Granit. In the background is the crucifix marking the spot where the dead of Sturmgruppe Granit were buried.The close-up photograph shows the actual damage to EBEN 2 as visible today. Although there was no penetration. the shock wave caused steel splinters and scabs to detach at high velocity from the interior surface, killing and wounding those inside. Above the damage is the circular slot for a periscope down which Feldwebel Wenzel jammed a l kg charge that wounded the observer in the initial attack.





The garrison

With almost 5km of underground tunnels and galleries connecting the various gun emplacements, resupply within Fort Eben Emael was a major task.Ammunition was transported in handcarts from the ammunition magazines to the gun emplacement by means of hoists, or in an emergency by hand up the stairwell. On the right is a 75mm ammunition cart and on the left a water bowser.



Fall Gelb - Case Yellow

(Oberkommando der Wehrmacht

Fall Gelb,

Position Fortifiee de Liege,

Fall Gelb.

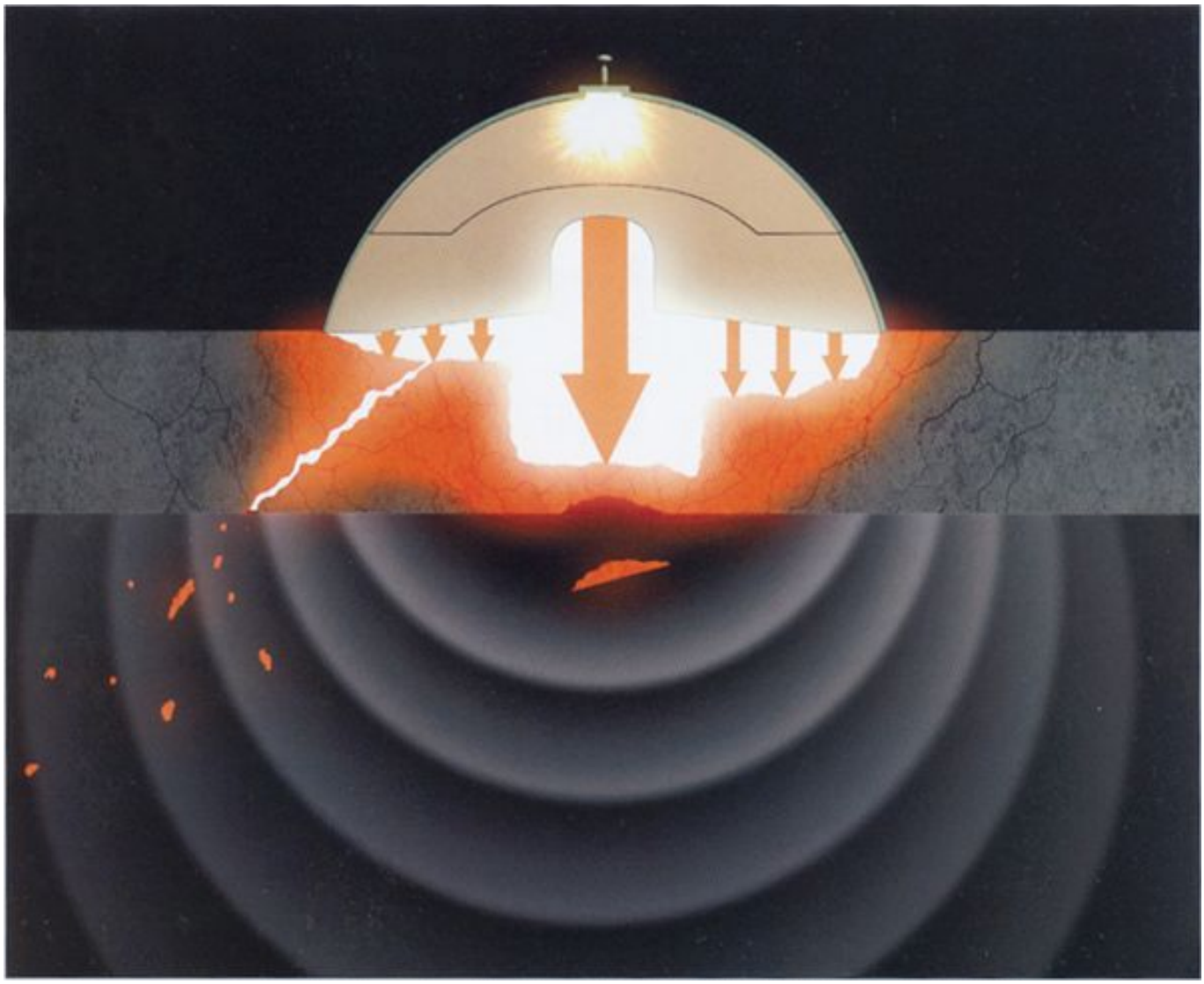
Fall Gelb
Schwerpunkt,

Fall Gelb

Fall Gelb

Sturmabteilung Koch

German Airborne Divisions:
Blitzkrieg 1940-41



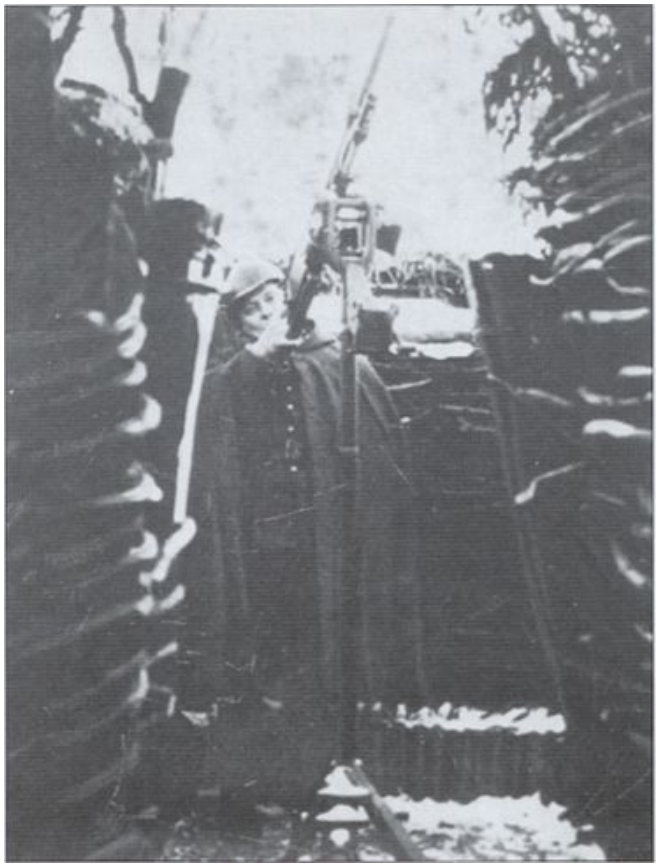
***Hohlladungwaffe* - hollow-charge explosive The** shaped or hollow-charge explosive principle was discovered in 1888 by an American, Charles Edward Munroe and it has become known as the 'Munroe Effect'. In 1910, it was improved by a German scientist named Egon Neumann. A Swiss chemical engineer, Henry Mohaupt, further refined the idea in the late 1930s and offered it to the French army, which was due to accept a hollow-charge anti-tank weapon on exactly the same day that the Germans first used their own version in anger, 10 May 1940. The largest 50kg *Hohlladungwaffe* came in two parts for easier handling by two men.The 50kg charge was delicate and any damage could result in a lesser explosive effect, which was one reason why they were delivered by glider rather than parachute. Also any damage to the seal between the two halves diminished the penetrative force significantly. Nevertheless, the *Hohlladungwaffen* proved highly effective on the day both militarily and psychologically. The priority targets were the armoured observation domes on the various gun emplacements. Although none was fully penetrated by the detonations, the blast and 'spalling' from fragments being detached from the interior surface of the domes were sufficient to kill and injure the Belgian observers and render the positions useless. The spalling effect and blast overpressure are shown to good effect in the artwork.The charges were also used to gain entry into the reinforced concrete gun emplacements by the assault pioneers of Sturmgruppe Granit.Thereafter, the remaining charges were used against targets of opportunity that further demoralised the Belgian garrison with their awesome destructive power.

Hohlladungwaffe

Saiikastelmottells,

glucklich Verheiratet

The paratroopers of the 7th Flieger Division wore a distinctive uniform of a jump smock and a different helmet to the classic German Stahlhelm.As all their weapons were dropped in separate containers, all paratroopers carried a pistol as a personal firearm for their immediate defence on landing.The standard pistol was the 7.65mm Sauer Modell 38H, or, later, the 9mmWalther P38.These were issued to glider troops as well, and the pistol holster is seen here on the equipment belt of Gefreiter Eddi Schmidt of Trupp 4. Beside him is Oberjager Ernst Grechza ofTrupp 5, who disgraced himself by becoming intoxicated during the attack after filling his water canteen with rum.There is no record of Grechza being injured during the action, so his bandaged head remains a mystery; either it was a self-inflicted wound through drunkenness, or else he might have got on the wrong end of Fw. Wcnzcl's fist for his antics. Ernst Grechza was killed in action on the island of Crete in 1941. Eddi Schmidt survived the war and died in 1991.
(Photo Centre de Documentation historiques des Forces armees)



Werk,

The principal defence of Fort Eben Emael against air attack was the MICA position located at the south-eastern end of the fortress; MICA standing for *mitrailleuse contre avions.* It comprised four machine-gun pits around a central command position, all interlinked by deep trenches.As anti-aircraft weapons, the machine guns were configured for firing skywards but they could also fire across the surface of the fortress as a further counter to infantry attack. In the event, two machine guns jammed without firing, one was knocked over by the wing strut of a DFS 230, and the other fired approximately 50 rounds before the position was overrun by the men ofTrupp 5 under the command of Feldwebel Haug.
(Fort Eben Emael)

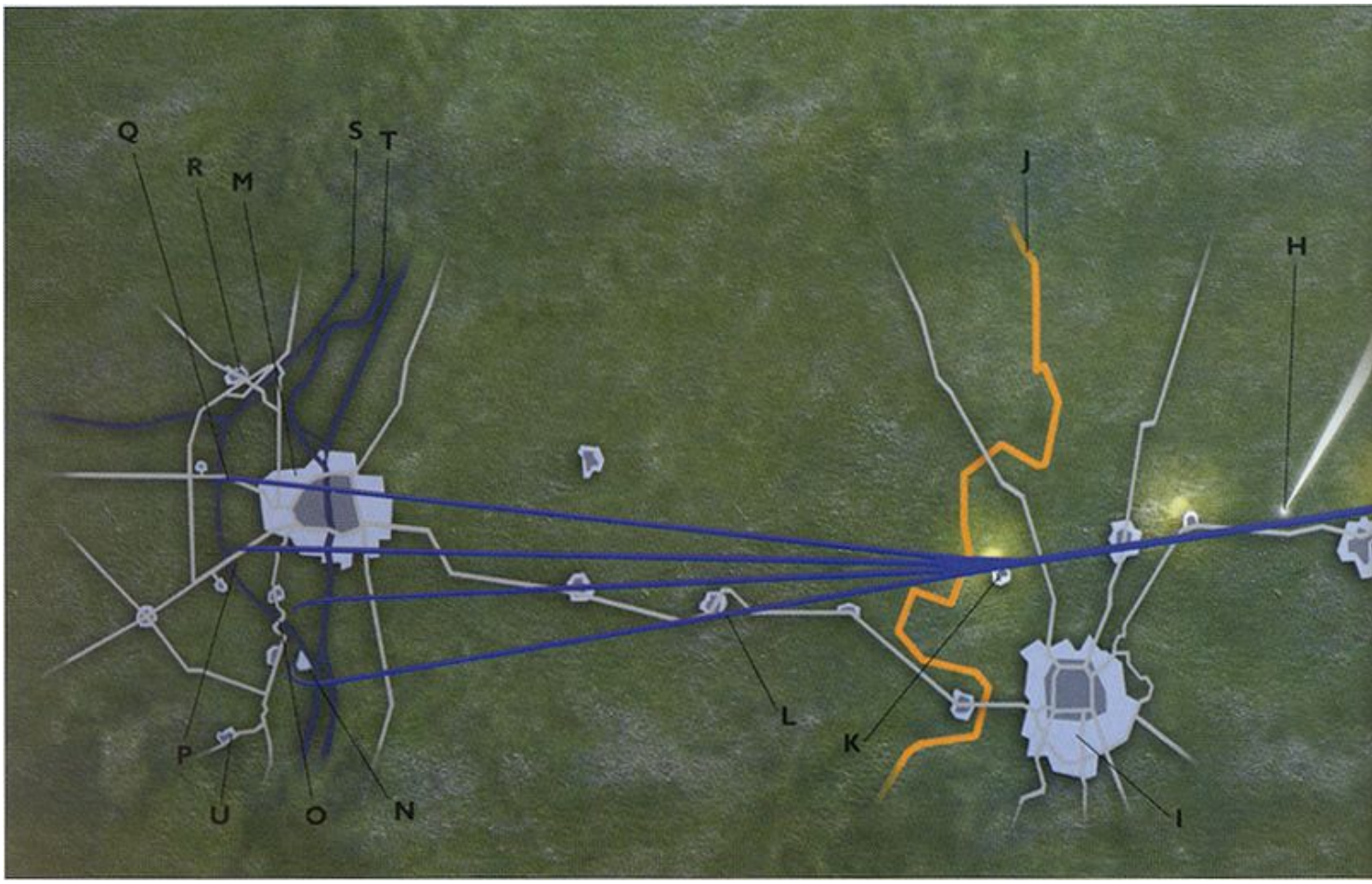
The other side of the hill

Position Fortifte de Liige,

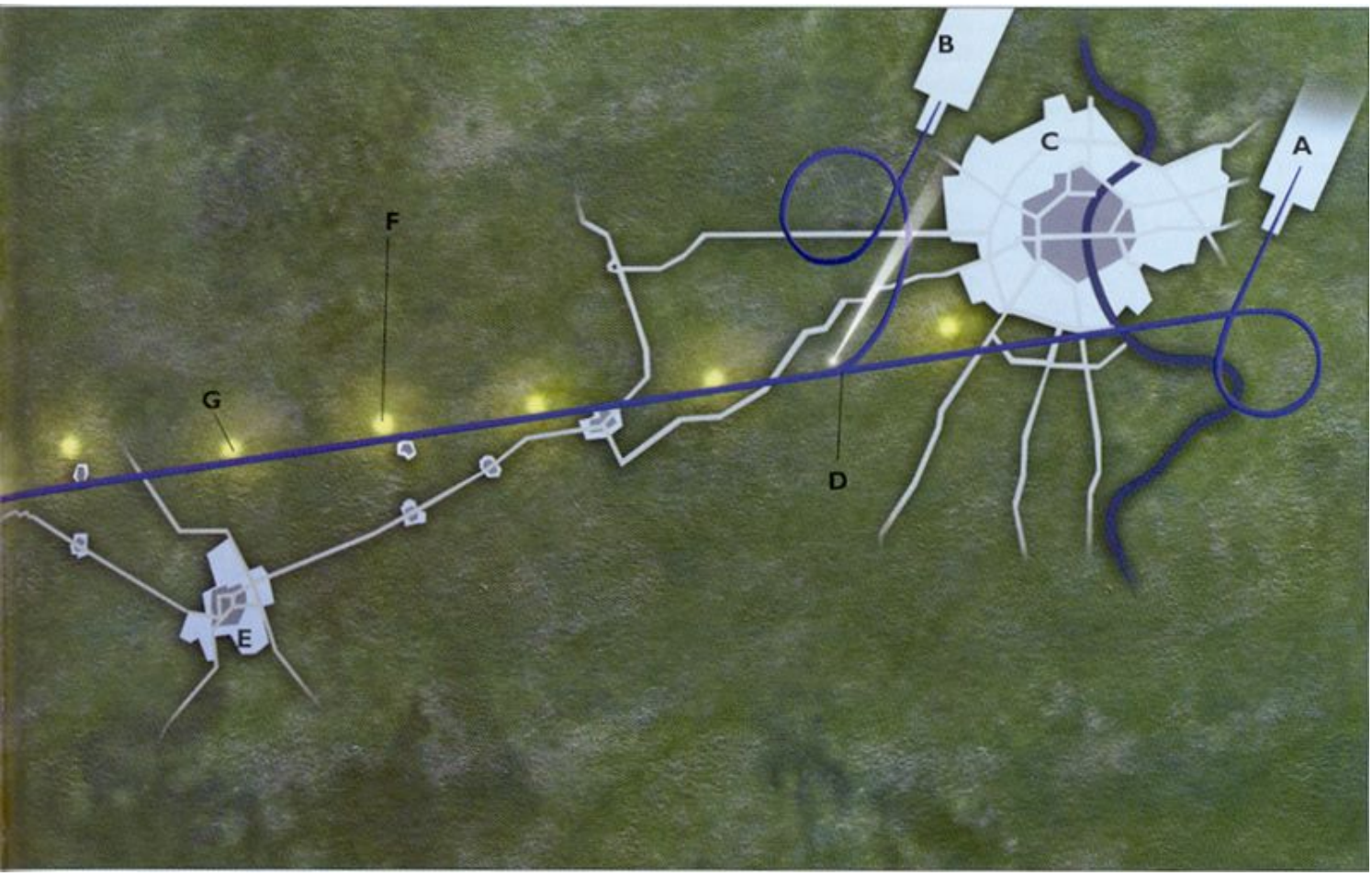
At 0830hrs on 10 May 1940. four hours after the attack on Fort Eben Emael began, the German ambassador presented himself at the Belgian Foreign Ministry. Before he could speak, the Belgian foreign minister, M. Paul Spaak. interjected -'I beg your pardon. Mr.Ambassador. I shall speak first,' and in an indignant voice he read the Belgian Government's protest, 'Mr.Ambassador, the German army has just attacked our country.This is the second time in 25 years that Germany has committed a criminal aggression against a neutral and loyal Belgium.What has just happened is perhaps even more odious than the aggression of 1914. No ultimatum, no note, no protest of any kind has ever been placed before the Belgian Government. It is through the attack itself that Germany has violated the undertakings given by her on 13 October 1937 and renewed spontaneously at the beginning of the war. The act of aggression committed by Germany for which there is no justification whatever will deeply shock the conscience of the world.The German Reich will be held responsible by history. Belgium is resolved to defend herself. Her cause, which is the cause of Right, cannot be vanquished.' In 18 days, the German Army crushed Belgium. Belgian neutrality had failed again. (National Archives and Records Administration)

The alert

Arguably, the fate of Fort Eben Emael was directly attributable to the two buildings outside the main entrance of Bloc I that were completely separate from the fortress. Of all the unfortunate circumstances that led to the fall of Fort Eben Emael. it was Major Jottrand's order to have the outside administrative buildings emptied and demolished that had such disastrous consequences. As there were too few men in the garrison, many members of the crews manning the gun emplacements were recalled to Bloc I to undertake the task, leaving the casemates severely undermanned, and, in the case of Mi-Sud, empty. In addition, the men from the 14 fighting foxholes dotted around the top of the fortress were all brought back to Bloc I, so there were no observers on top of the fortress at the time of the German attack. If they had been in position. there was every likelihood that the gliders would have been spotted sooner, giving the defenders more warning. But then again, each of the foxholes was supposed to be equipped with a field telephone connected to the command post, but they had been lent to a camp at Helchteren. In the event, neither of the buildings was demolished in time, and most of the damage visible here was sustained during Stuka attacks. It begs the question that if these buildings had to be demolished at the time of an attack alert why this had not been done in any of the previous four alerts. (Photo Centre de Documentation historiques des Forces armees)



'The sun shines red, be ready'

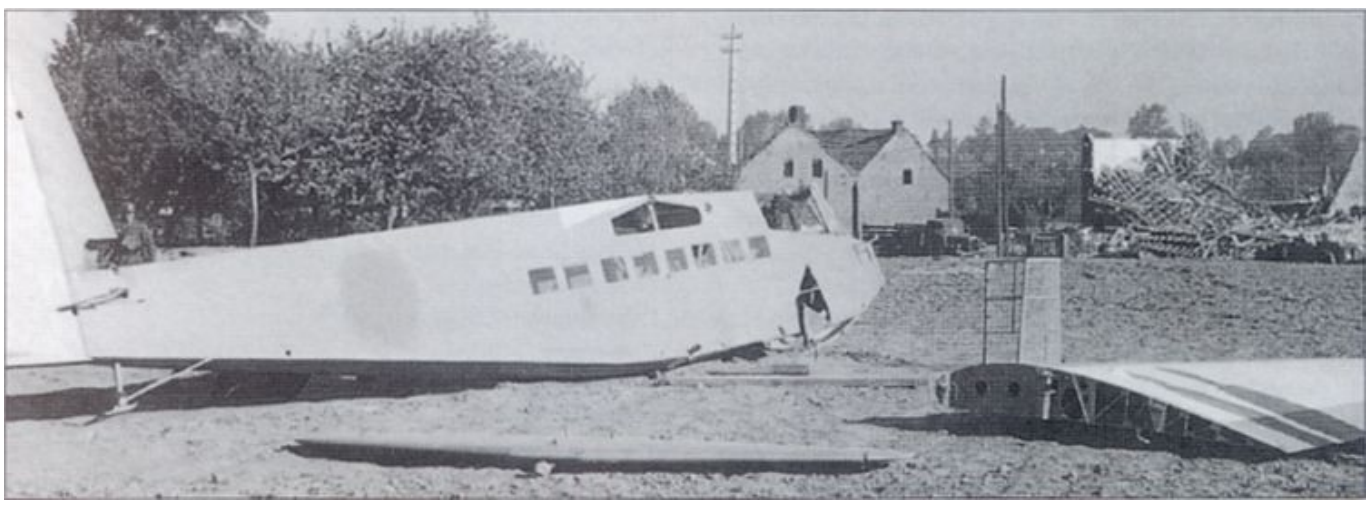


Flightpath

On Friday 10 May 1940. the air operations of Sturmabteilung Koch required 42 gliders and their attendant Ju52s as well as six additional Ju52s to drop an extra 73 Fallschirmjager at the bridges. 24 atVeldwezelt, 24 atVroenhoven and 25 at Kanne. some 40 minutes after the initial glider landings. Three gliders aborted with two belonging to Sturmgruppe Granit but one of these arrived later containing Lt. Rudolf Witzig, the commander of Sturmgruppe Granit.This diagram shows the flight path of the assault force from the airfields of Koln-Butzweilerhof and Koln-Ostheim with the series of bonfires and searchlights that indicated the route to the Dutch border.Ten Ju52/DFS 230 combinations took off from Butzweilerhof and 32 from Ostheim including the I I gliders of Sturmgruppe Granit.The rallying point was around the first searchlight pointing vertically into the air close to the village of Frechen.The line of beacons was a combination of huge bonfires, rotating lights and vertically pointing 60cm anti-aircraft searchlights that were illuminated for 30 seconds and then extinguished for ten seconds; the sequence being repeated throughout the flight.With the rest of Germany lying in pitch darkness because of the wartime blackout, die lights were readily visible to die aircrew.The distance between Koln and Aachen was 72km and the air flotilla was to reach the release point for the gliders at a height of 2.600m (8.500ft) in 32 minutes at a speed of 140km/hr but due to a strong tail wing, it took longer dian expected to climb to the designated altitude so the actual release point was over Dutch territory rather than north-west of Aachen as planned. Once released, die gliders achieved a speed of 124km/hr at a glide angle of 1:12 to travel the average distance of 27km to the targets in just under 14 minutes. The first glider landed on Fort Eben Emael at 0424hrs Belgian time, which was one hour behind German or Central European Time.

KEY

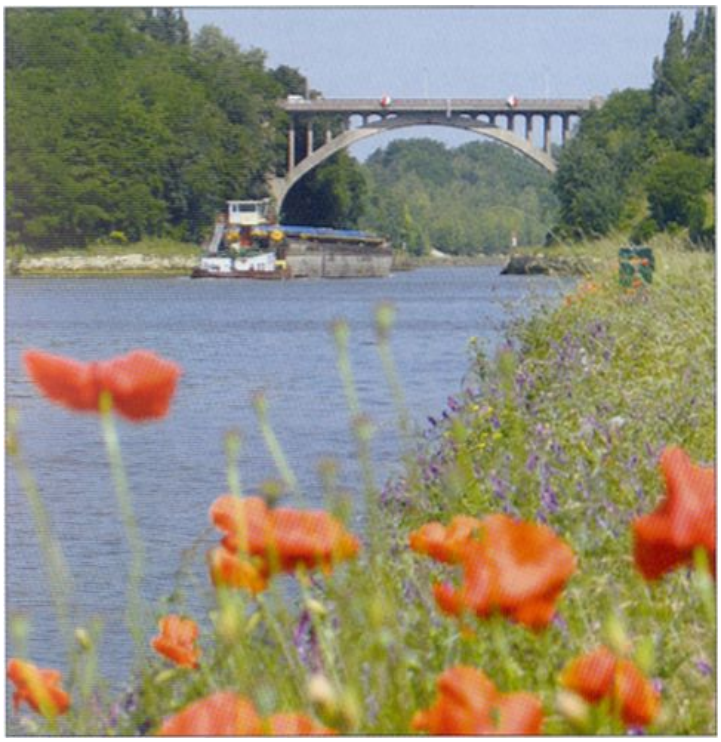
A. Ostheim aerodrome
B. Butzweilerhof aerodrome
C. Cologne - Koln
D. Rallying point near Efferen
E. Duren where the glider of Trupp 2 landed
F. Bonfires on flightpath
G. Rotating lights on flightpath
H. Vertical pointing searchlights on flightpath
I. Aachen - Aix-la-Chapelle
J. Border of Germany and Holland
K. Proposed release point for gliders
L. Actual release point for gliders over Gulpen
M. Maastricht
N. Fort Eben Emael
O. Kanne bridge
P. Vroenhoven bridge
Q. Veldwezelt bridge
R. Lanaken
S. Albert Canal
T. Meuse River
U. Wonck



The first glider assault in warfare

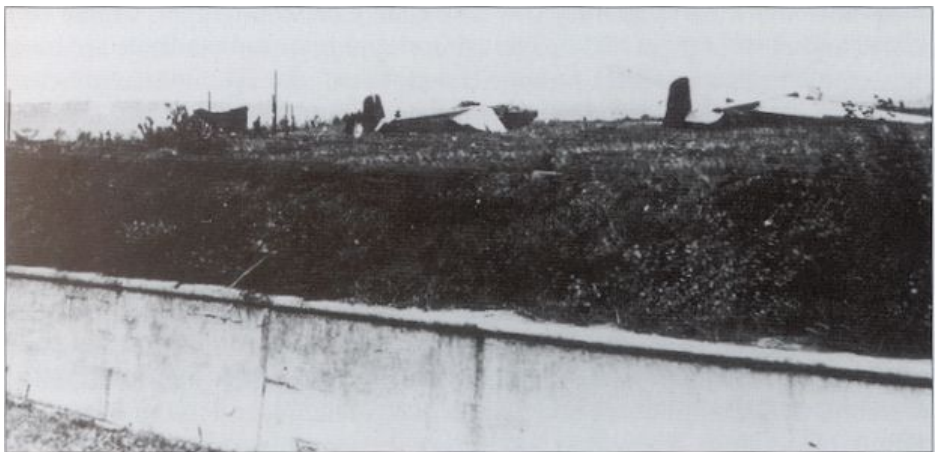
Fall Gelb

Sturmgruppe Stahl captured the bridge at Veldwezelt intact at a cost of eight dead and 30 injured. Soon after landing, the paratroopers attacked Bunker" N on the western side of the Albert Canal, visible here at the end of the bridge in the background.The 12 occupants of the bunker from the Escadron des Cyclistes-Frontiere du Limbourg were killed outright. Beneath the bridge, built into the pile, was Bunker C. which was also attacked with explosives, trapping those inside. Early in the evening of 10 May, the first elements of the 4th Panzer Division arrived at the bridge and the first tanks to cross. shown here, were from the 2 Zug, 6 Kompanie of Panzer Regiment 36, commanded by Oberstleutnant Jesser.The men caught inside Bunker C were from the 6e Compagnie of the 2e Carabiniers. They were not released until 1100hrs on the following day. when the distorted door was prised open by German engineers. Over the next few days, the Belgian, French, and Royal air forces mounted bombing raids against the captured bridges. On 12 May, No. 12 Squadron, Advanced Air Striking Force, undertook a mission. Flying slow and vulnerable Fairey Battle bombers, four of the five aircraft that attacked the Veldwezelt bridge were shot down, but Flying Officer Donald Garland and his observer, Sergeant! Gray in P2204 PH-K, were posthumously awarded the first RAF Victoria Crosses of World War II.
(National Archives and Records Administration)



As one of the observation posts of Fort Eben Emael. Bloc 0 overlooked the Kanne bridge across the Albert Canal. It was manned by three members of the garrison, and was armed with one 47mm anti-tank gun and one machine gun. On the orders of Maj. Jottrand, the bridge was blown up as the gliders of Sturmgruppe Eisen landed nearby. Later in the day, the men of Trupp 2 of Sturmgruppe Granit under the command of Oberjager Maier arrived at Kanne. After their glider had landed in Germany, Maier had commandeered some trucks and drove through the advancing columns of the German Army to get to Fort Eben Emael as quickly as possible.Trupp 2 captured 121 Belgian prisoners of war, but Maier would not hand them over without a receipt to prove that he had done everything in his power to complete his mission.Tragically. Oberjager Max Maier did not live to see the victory of Sturmgruppe Granit as he was killed during the fierce fighting in Kanne on 10 May, but he was buried with his comrades on the heights of Fort Eben Emael. (National Archives and Records Administration)

The assault of Sturmgruppe Granit



The gliders ofTruppe 5 and 8 were the first to land on Fort Eben Emael, with the DFS 230 of Trupp 8 touching down at 0424hrs in the first glider-borne assault in the history of warfare. While the men of Trupp 8 attacked Coupole Nord, Trupp 5 tackled the MICA anti-aircraft position.This can be seen to the left of the photograph, with the DFS 230 of Trupp 5 in the middle and that of Trupp 8 to the right. In the foreground is the anti-tank ditch, and behind the glider of Trupp 8 was the Graindorge barracks.This building housed the personnel that maintained and repaired the various weapons of Fort Eben Emael. To the left of the photograph, the wooden MICA hut is just visible on the skyline. It contained two spare machine guns. Ironically, it was these two weapons firing from a wooden structure that caused the first German fatalities of the assault rather than the purpose-built machine-gun emplacements of Mi-Nord and Mi-Sud. (Photo Centre de Documentation historiques des Forces armees)

The chaplain of Fort Eben Emael, L. Meesen, kept a diary of events that give an interesting insight into the atmosphere inside the fortress at the time of the attack:

Thursday, 9 May 1940. The news is good tonight - five-day leave passes have been reinstated.The troops are making plans. As for me, I have decided to take three days off between 20 and 23 of May ... Around 9 o'clock, we go back to the fort Not knowing what to do at the village many soldiers are returning as well.The news about the restoration of leave is spreading. Once again everything is going extremely well ...Half past twelve at night We are woken up by the sound of a bugle and pandemonium in the galleries. It's the alarm. Is it real this time or will it be another drill again! And what about our leave? The outcome of each alert has always been the cancellation of leave for an unspecified length of time ... Everything is quiet No sound or light from the village.As with every other alarm everything from the outside buildings has to be moved into the fort - officers' mess, records and files.The men are working willingly. Nobody is expecting a war. Some of them however, thinking of their leave, are working reluctantly ... I intend to go back when I am told that twenty gunshots will be fired from Coupole 120 [sic].This seems to be getting serious. Could this really mean war? The major [jottrand] has been told that the turret is not working.An act of sabotage? I believe the shots will be fired from another cupola [Mi-Sud]. At that time I reached my room inside the fort and I couldn't hear the twenty shots being fired ... Father Lamaye who did not leave comes to see me around four thirty - "We are at war!" he says "German planes have landed on the fort" So it is real this time. I put my helmet on, take my gas mask and we go out into the passage ... The men are bustling about everywhere. What is going on above us? ... I am going to the infirmary. Our three doctors are there, Commandant Willems and Lieutenants Dumay and Steegen. Doctor Steegen tells us that he has seen planes coming down onto the fort The machines were flying silently, their engines stopped.Yet at that time we didn't know they were planes without engines - gliders!'

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Attaque generate,

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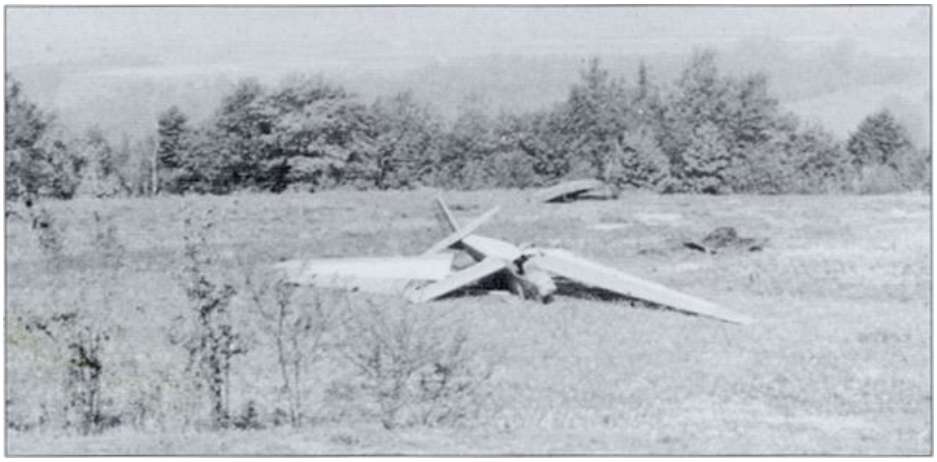
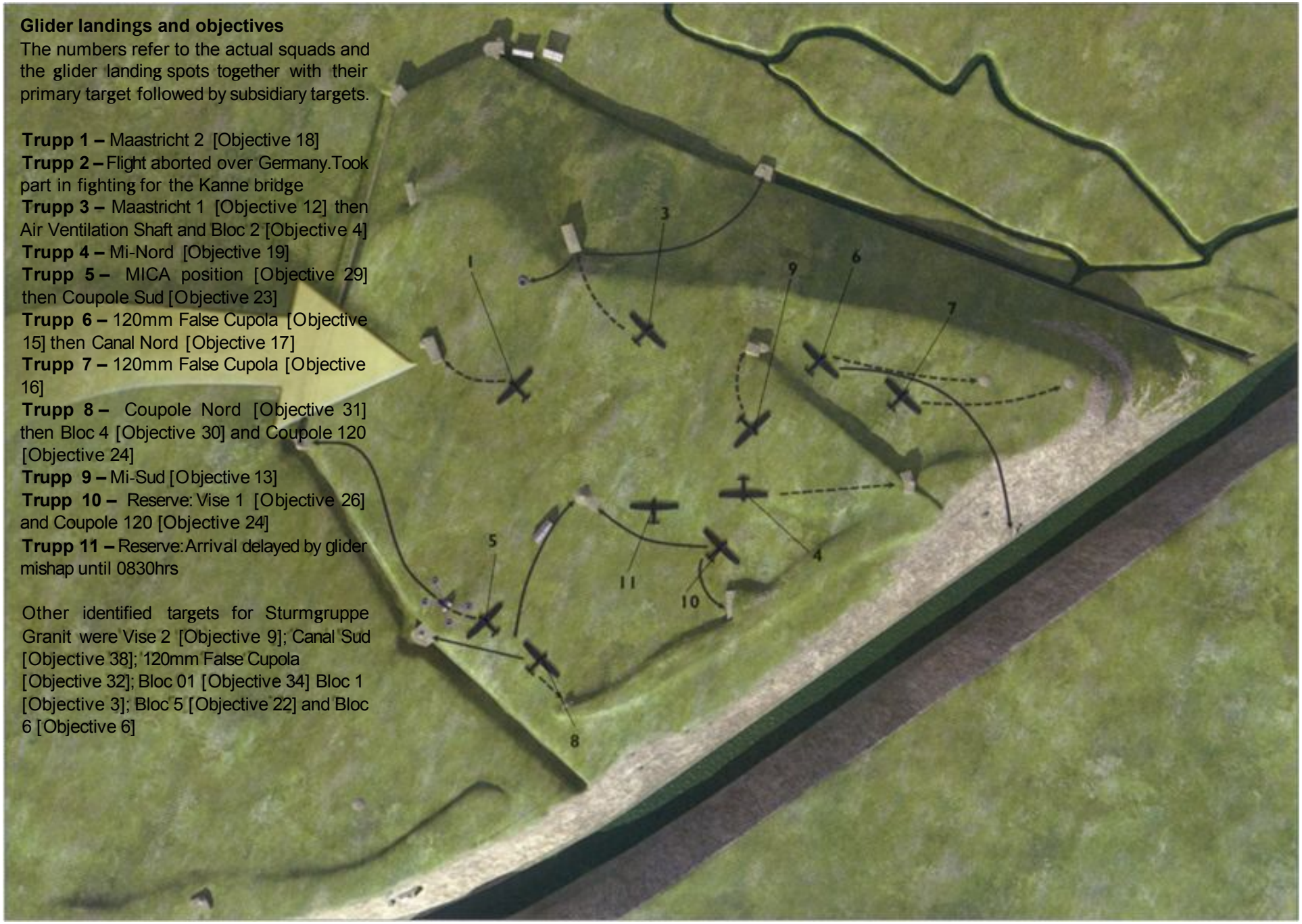


The remains of the DFS 230 of Trupp 7 lie broken on the north-western edge of Fort Eben Emael. The glider pilot, Unteroffizier Heinz Scheithauer, and GefreiterWilhelm Hopfner were severely injured during the landing and took no further part in the fighting. Behind the glider are the remains of one of the false cupolas that Trupp 7, under the command of Oberjager Fritz Heinemann, destroyed soon after landing. The other false cupola, complete with dummy guns, that appeared identical to Coupole 120, was the target for Trupp 6.These false cupolas were mounted on a rotating ballrace so that their aspect could be altered to confuse aerial reconnaissance. This serious lapse of German intelligence wasted the efforts and resources of two whole squads, or almost 25 per cent of the landing force, at a critical juncture of the battle. The DFS 230 was designed and built by the Deutsches Forschungsinstitut fur Segelflug. hence the designation DFS. It first flew in 1937 and 1,022 were built by Gothaer Waggonfabrik between 1938 and 1941. It comprised a lattice of steel tubes covered with fabric to form the fuselage, and a high shoulder-mounted plywood wing. With an unladen weight of 860kg, it had a maximum take-off weight of 2,100kg, although those of Sturmabteilung Koch were probably overloaded and this caused some towropes to break.The DFS 230 cost just 7,500 Deutsche Marks, which was equivalent to the price of ten RZl6 parachutes of the time. 10 May 1940 was the first time that gliders were used offensively in warfare.
(Photo Centre de Documentation historiques des Forces armees)

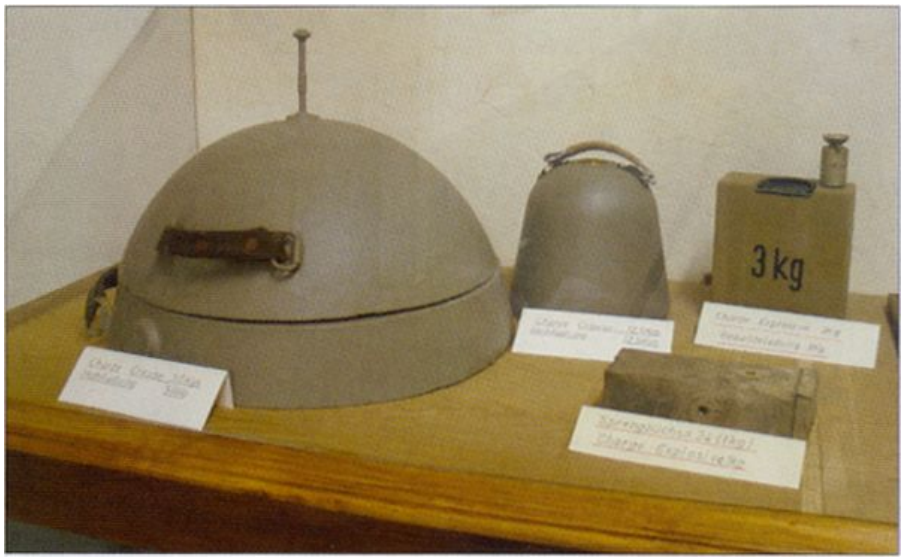


Glider landings and objectives

The numbers refer to the actual squads and the glider landing spots together with their primary target followed by subsidiary targets.

Trupp 1 – Maastricht 2 [Objective 18]
Trupp 2 – Flight aborted over Germany.Took part in fighting for the Kanne bridge
Trupp 3 – Maastricht 1 [Objective 12] then Air Ventilation Shaft and Bloc 2 [Objective 4]
Trupp 4 – Mi-Nord [Objective 19]
Trupp 5 – MICA position [Objective 29] then Coupole Sud [Objective 23]
Trupp 6 – 120mm False Cupola [Objective 15] then Canal Nord [Objective 17]
Trupp 7 – 120mm False Cupola [Objective 16]
Trupp 8 – Coupole Nord [Objective 31] then Bloc 4 [Objective 30] and Coupole 120 [Objective 24]
Trupp 9 – Mi-Sud [Objective 13]
Trupp 10 – Reserve: Vise 1 [Objective 26] and Coupole 120 [Objective 24]
Trupp 11 – Reserve:Arrival delayed by glider mishap until 0830hrs

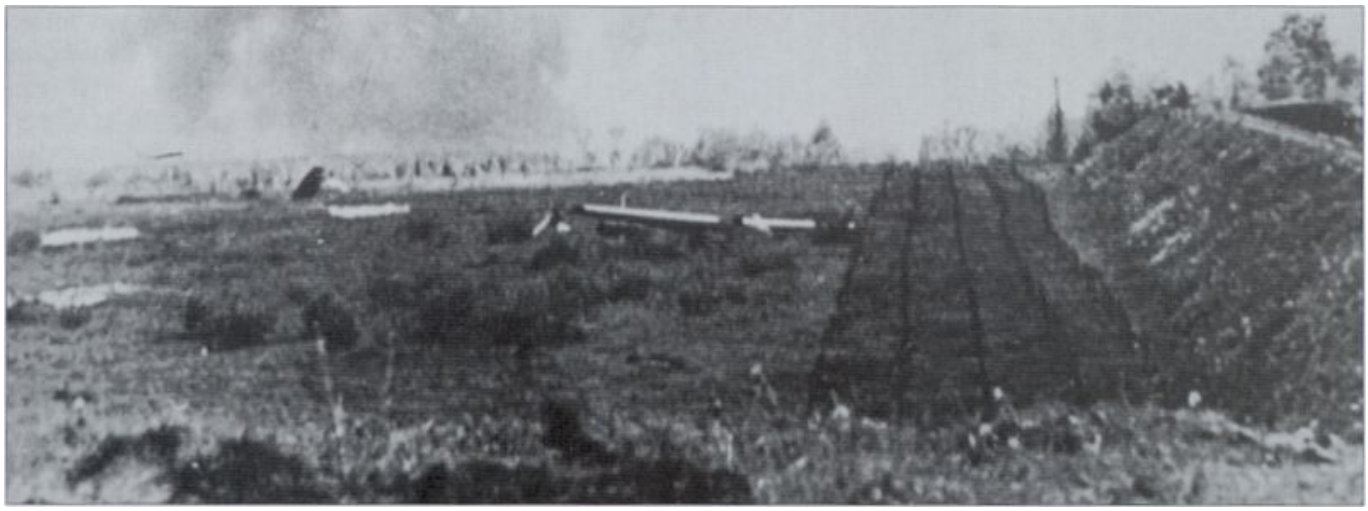
Other identified targets for Sturmgruppe Granit were Vise 2 [Objective 9]; Canal Sud [Objective 38]; 120mm False Cupola [Objective 32]; Bloc 01 [Objective 34] Bloc 1 [Objective 3]; Bloc 5 [Objective 22] and Bloc 6 [Objective 6]



The museum at Fort Eben Emael contains many interesting artefacts including these hollow-charge weapons, or *Hohlladungwaffen,* and explosive charges as used by Sturmgruppe Granit during the assault on the fortress. On the left is the two-piece 50kg charge with the leather carrying handles and the fuse at the top. Beside is the compact H12 *Hohlladungkorper* 12.5kg hollow-charge weapon that proved so effective against the triple 75mm gun emplacements.The other two devices are standard explosive demolition charges in 3kg and 1 kg sizes. Feldwebel Wenzel used the latter type in his initial attack on EBEN 2 of Mi-Nord, while the 3kg charge was used to great effect to destroy stairwells to prevent Belgian counter-attacks against the captured gun emplacements.

Hohlladungwaffe

Stuka dive-bombers repeatedly attacked the main entrance to Fort Eben Emael at Bloc I, causing considerable superficial splinter damage to the face of the casemate. Direct-fire weapons, mainly 37mm PaK anti-tank guns that were concealed near the watermill on the Geer River facing Bloc I. caused most of the damage around the gun embrasures.This view shows the northern aspect of Bloc I with the 60mm anti-tank gun at the bottom, the machine-gun embrasure above, and the searchlight housing to the right. At the top left are the steps that gave access to the top of the fortress. In another excerpt from the chaplain's diary, this one from Friday afternoon. Through the periscope of Bloc Is machine gun, many soldiers can be seen arriving in twos and threes at the front gate of the fort from Wonck.They are being let in and arrive, totally deadbeat. It took them three, four hours along a road that they would normally take them 30 minutes. All along the way, they have suffered bombing and strafing .. I go to the gate to welcome those who are coming in. Some are weeping from exhaustion. As soon as they get in. they fall to the ground in a heap, refusing to move ... I settle them down and tell them to rest for a few hours. For the time being no one knows what to do with them anyway and besides, they are unable to do anything at the moment."
(Fort Eben Emael)



This remarkable photograph shows the view from the German command post of Mi-Nord during the course of the fighting of 10 May. with Belgian artillery shells bursting on the surface of the fortress. To the right is the earth embankment between Mi-Nord and Mi-Sud, with the barbed wire entanglements to its front. In the middle distance is the DFS 230 of Trupp 9, whose primary target was Mi-Sud. In the distance to the left is the DFS 230 of Trupp I. whose primary target was Maastricht I. situated in the far background.The white shapes on the ground are the parachutes of the resupply containers. During the course of the battle, the Belgian artillery of the surrounding units and the forts to the south. Barchon. Evegnee and Pontisse. fired some 2,200 shells onto Fort Eben Emael. Sheltered in their captured casemates, the barrage had little but nuisance effect on Sturmgruppe Granit. and the Belgian artillery would have been better served by bombarding German units attempting to cross the Meuse River and Albert Canal. This photograph was taken by Helmut Wenzel, who normally went into action with a pair of binoculars and a camera around his neck.
(Fort Eben Emael)

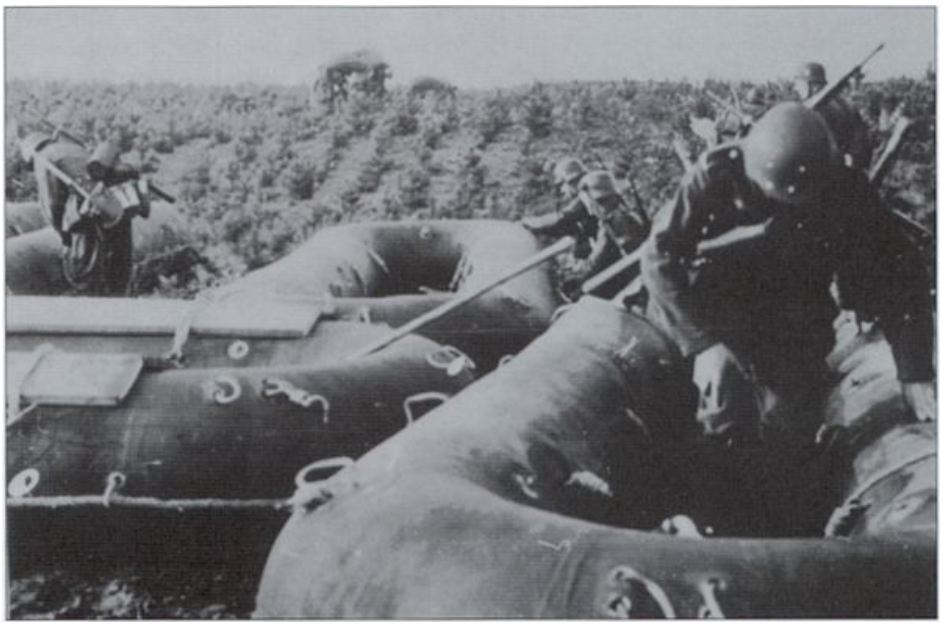
well

Antique xmerale.

During the morning of 11 May, OberleutnantWitzig kept the garrison off-guard by repeatedly setting off explosive charges that reverberated throughout the fortress and further demoralized the Belgian defenders. The most devastating of these occurred at 0850hrs when a 50kg charge was detonated against the armoured doors of Maastricht I on the intermediate level. The massive explosion blew off the internal door, killing six Belgian soldiers and wounding several others. The dead were privates Corombelle, Dujardin, Gillet. Lebeau, Martin and Massotte. The blast wave funnelled down the tunnels and galleries, causing barrels of calcium chloride stored in the open passageways to burst and exude noxious fumes. The Belgian defenders now believed they were under a gas attack, and were forced to wear gasmasks to combat the fumes. It was another serious blow to an already demoralized garrison. The chaplain's diary continues - 'The bombs are still making the fort shake to its foundations. Maastricht I and Mi-Nord are said to have exploded.The wounded keep arriving at the infirmary. Gillet is brought to the infirmary, dying. His face and hands are burnt black ... As for Massotte. he is still conscious when they bring him to the infirmary ... I administer the extreme unction and together we say the prayers for the dying. He passes away very quietly in front of his comrades.'

The long lingering death of Fort Eben Emael

Specially configured units backed Sturmabteilung Koch in order to provide fire support and reinforcement as soon as possible after the capture of the bridges.The main one was Infanterie Regiment 151, with the attached Pionierbataillon 51.As a motorized formation, it came under 'Marschgruppe Rot' of the 4th Panzer Division, and was at the forefront of the advance. In addition, there was Flakabteilung Aldinger with three heavy and two light Flak batteries.The 88mm Flak guns also gave fire support to the paratroopers, while the light Flak batteries were tasked with providing anti-aircraft defences around the captured bridges against Allied bombers. The men of Pionierbataillon 51 were issued with inflatable assault boats and they were used to cross the Albert Canal below Kanne to link up with Sturmgruppe Granit on the morning of l l May. The commander of the pioneers, Oberstleutnant Mikosch, actually accepted the surrender of Fort Eben Emael from Maj.Jottrand soon after midday after he had been promised that there were no time delay demolitions in the fortress. (National Archives and Records Administration)



The chaplain's final diary entry reads: 'Captain Vamecq. ordered to negotiate the surrender, heads for the entrance of the fort escorted by I private holding a white flag but the Germans keep firing. A second attempt gets a better result.The firing ceases and negotiations begin. It takes some time before he returns. Unconditional surrender has been demanded. German soldiers approach the fort.The garrison is ordered to lay down their arms and to form ranks four abreast to leave the fort with officers in front.The medical personnel are to stay in the fort with the wounded.They will be looked after later on.While the men get rid of their weapons and form ranks we stay at the cross roads of the underground galleries. I shake hands with all those passing by. Slowly the column leaves the fort, which now becomes silent.' In all, the garrison sustained 21 dead and 61 wounded. Sturmgruppe Granit suffered six fatalities during the assault of Fort Eben Emael, including the death of Oberjager Maier of Trupp 2 during the fighting around the Kanne bridge.All six were buried at the northernmost tip of the fortress overlooking the Albert Canal beneath a large crucifix.The six dead paratroopers were Oberjager Max Maier, Ober|ager Willi Hubel. Oberjager Otto Unger, Obergefreiter Helmuth Bogle, Gefreiter Kurt Jurgensen and Gefreiter Fritz Kruck.The bodies were subsequently moved to the military cemetery atYsselsteyn in Holland, where they rest to this day.

After the battle for Fort Eben Emael and the Albert Canal bridges, the paratroopers of Sturmabteilung Koch were feted as heroes in the German press, and many of them featured on postcards such as this one of Leutnant Egon Delica, the air liaison officer.The illustration shows Lt. Delica in the distinctive paratrooper's smock and helmet, as well as the Ritterkreuz he received from the hands of Adolf Hitler on 16 May 1940. Over his shoulders are representations of Fort Eben Emael, including Coupole 120 and the Caster cutting.At top left is the insignia of the 7th Flieger Division, the parent organisation of Sturmabteilung Koch. It is curious that Lt. Delica landed with Trupp I when the only radio and its operators were with Trupp 10. For much of the battle, Lt. Delica sheltered inside the casemate Maastricht I while the radio was with Fw.Wenzel at Mi-Nord.The latter coordinated Luftwaffe air support and communicated with the forward headquarters of Sturmabteilung Koch although, as an officer, Lt. Delica was of a superior rank and Oberleutnant Witzig's nominal deputy.

Blame and counterblame

Fall Gelb

Position Fortifiie tie Liege

Auftragstaktik

Auftragstaktik

Auftragstaktik

The officers of Sturmabteilung Koch being presented the Ritterkreuz for their part in the assaults on Eben Emael and the bridges over the Albert Canal on 10 May 1940.The photo was taken on 16 May at Fiihrerhauptquartier 'Felsennest', 50km south-west of Bonn. From left to right: Hauptmann Walter Koch, Oberleutnant Rudolf Witzig, Oberleutnant Gustav Altmann. Other officers present are: Oberleutnant Otto Zierach, Oberarzt Dr. Rolf Jager, Leutnant Egon Delica, Leutnant Helmut Ringier. Leutnant Joachim Meissner, Leutnant Gerhard Schacht. Not present was Leutnant Martin Schachter, who remained in hospital after being wounded during the fierce fighting at Kanne.

Auftragstaktik,

Attaque

generate *Attaque massif,*

Fort Eben Emael remains a Belgian army installation to this day and is subject to military law. It was not until 1986 that the general public was allowed to visit the site.The association 'Fort Eben Emael' - FEE - was founded to preserve the memory and the fabric of the fortress. FEE was recognized by the military authorities on 15 January 1988, and thereafter the association has conducted guided tours for the public. However, these are limited to a very specific number of weekends in the year, unless a special visit is arranged in advance. Since 1988, FEE with the assistance of the Belgian Ministry of Defence has refurbished some of the interior rooms and gun emplacements.There is also a museum containing many artefacts of the period.A guided tour of the fortress interior takes approximately two hours, and the dates for the weekend visits are posted on the internet. For further information, consult http://www.fort-eben-emael.be (Courtesy Fort Eben Emael)

FORT
EBEN-EMAEL
FORT
FEE
A.S.B.L.
EBEN-EMAEL
En 1940, fleuron des forts de Liège et réputé imprenable. Aujourd'hui, un musée, un lieu d'histoire et de mémoire
In 1940, de bloem van de forten van Luik en onin neembaar. Vandaag, een historisch museum en een herinnering plaats

After many years of neglect, the interior of Fort Eben Emael is gradually being refurbished as part of a public museum.This shows the NCOs' sleeping quarters in the main underground accommodation area of the *Caserne Souterraine.*

The Fort Eben Emael of today is much different from the fortress of May 1940. With over 60 years of growth, much of the terrain is overgrown with mature trees and vegetation, while the top surface is now farmland. This view shows the top of Coupole Nord looking southwards to Coupole Sud. Between the two gun emplacements were the MICA anti-aircraft position and, to the right, the Graindorge barracks.The DFS 230 gliders made their final approach from the south, sweeping low over Coupole Sud, with those of Truppe 5 and 8 landing in the foreground close to Coupole Nord.The detonation points of the two 50kg hollow-charge weapons are visible on Coupole Nord and, interestingly, it is possible to see the pattern of the camouflage netting fused into the steel by the heat of the explosions.

Organization of Sturmgruppe Granit

Truppl EBEN 3 and Maastricht 2 - 1:2:5

Trupp 5 MICA anti-aircraft position - 0:3:5

Trupp 2 Coupole 120 - 0:3:5

Trupp 6 False cupola at northern end of fortress - 0:3:5

Trupp 3 Maastricht 1 - 0:2:5

Trupp 7 False cupola at northern end of fortress - 0:2:6

Trupp 4 EBEN 2 and Mi-Nord -0:2:6

Trupp 10 Reserve - 0:3:5

Trupp 8 Coupole Nord - 0:3:5

Trupp 11 Reserve 1:2:4

Trupp 9 Mi-Sud 0:3:4

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Fortress 30

Design, technology and history of key fortresses, strategic positions and defensive systems

Fort Eben Emael

The key to Hitler's victory in the West

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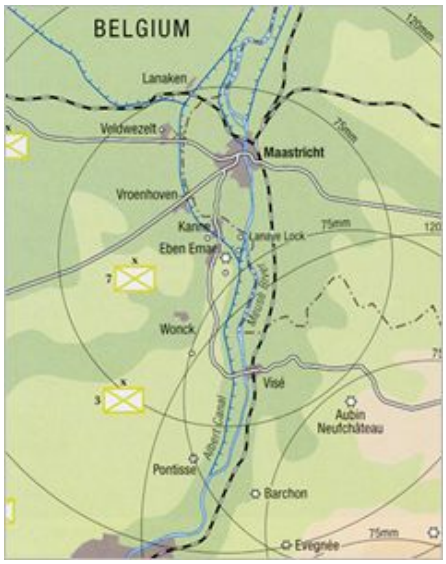

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